TECHNICAL DATA 0
DIAGNOSTICS 1
MECHANICAL GEARBOX CONTROL 2
PNEUMATICALLY ASSISTED GEARBOX CONTROL (SERVOSHIFT) 3
GEARBOX - PNEUMATIC SECTION 4
ZF 6S-850 GEARBOX 5
ZF 8/9/16S-109 GEARBOX 6
ZF 8/16S-151/181 AND 16S-221 GEARBOXES 7
EATON FS/6309A GEARBOX 8
AUTOMATIC GEARBOXES 9
CLUTCH 10
PROP SHAFTS 11
ZF INTARDER 12
PTO 13
AS TRONIC GEARBOX 14

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CONTENTS

		Page	Date
1.	**MECHANICAL GEARBOX CONTROL**	1-1	200337
1.1	General	1-1	200337
1.2	Tightening torques	1-3	200337
2.	**PNEUMATICALLY ASSISTED GEARBOX CONTROL (SERVOSHIFT)**	2-1	200337
2.1	General	2-1	200337
2.2	Tightening torques	2-1	200337
3.	**PNEUMATIC SECTION OF GEARBOX**	3-1	200337
3.1	General	3-1	200337
3.2	Tightening torques	3-4	200337
4.	**ZF 6S-850 GEARBOX**	4-1	200337
4.1	General	4-1	200337
4.2	Tightening torques	4-2	200337
4.3	Filling capacities	4-2	200337
5.	**ZF 8/9/16S-109 GEARBOX**	5-1	200337
5.1	General	5-1	200337
5.2	Tightening torques	5-2	200337
5.3	Filling capacities	5-4	200337
6.	**ZF 8/16S-151/181 AND 16S-221 GEARBOXES**	6-1	200337
6.1	General	6-1	200337
6.2	Tightening torques	6-2	200337
6.3	Filling capacities	6-4	200337
7.	**EATON FS/6309A GEARBOX**	7-1	200337
7.1	General	7-1	200337
7.2	Tightening torques	7-2	200337
7.3	Filling capacities	7-3	200337
8.	**ALLISON AUTOMATIC GEARBOX**	8-1	200337
8.1	General	8-1	200337
8.2	Tightening torques	8-2	200337
8.3	Filling capacities	8-3	200337
9.	**CLUTCH**	9-1	200337
9.1	General	9-1	200337
9.2	Tightening torques	9-5	200337
9.3	Filling capacities	9-6	200337
10.	**PROP SHAFTS**	10-1	200337
10.1	General	10-1	200337
10.2	Tightening torques	10-2	200337
10.3	Filling capacities	10-3	200337
11.	**ZF INTARDER**	11-1	200337
11.1	General	11-1	200337
11.2	Tightening torques	11-1	200337

0

	Page	Date
12. PTO	12-1	200337
12.1 General	12-1	200337
12.2 Tightening torques	12-2	200337
12.3 Filling capacities	12-4	200337
13. AS TRONIC GEARBOX	13-1	200337
13.1 General	13-1	200337
13.2 Tightening torques	13-2	200337
13.3 Filling capacities	13-4	200337

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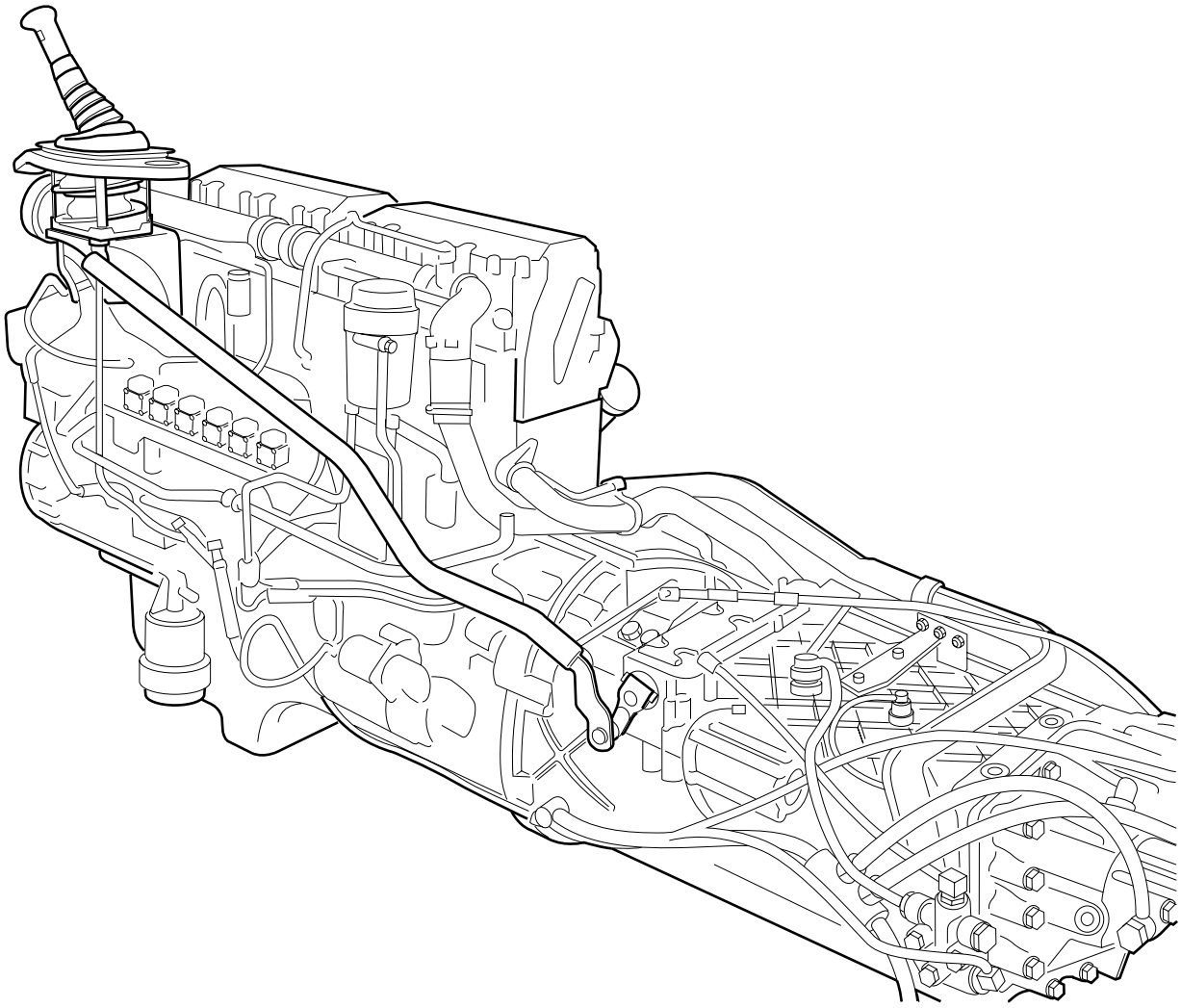
1. MECHANICAL GEARBOX CONTROL

1.1 GENERAL



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- Within the entire *CF*65/75/85 vehicle series many gearbox variations as well as the accompanying controls are possible, both mechanical and pneumatic.
- A gearbox with a splitter and range-change switch will be equipped with several pneumatic valves.

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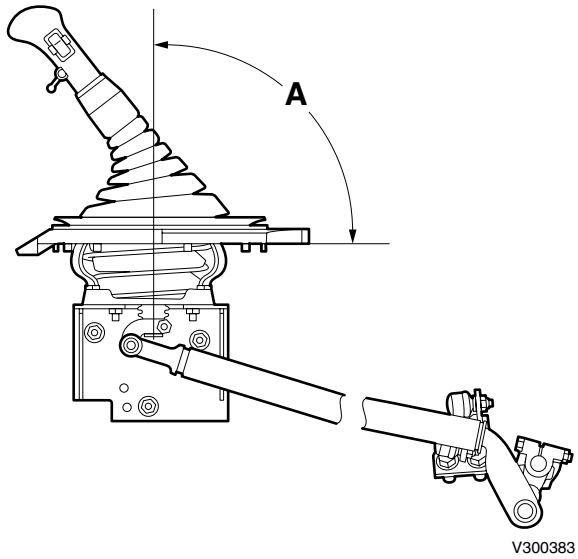
ADJUSTING THE LINKAGE MECHANISM

Vehicle series *CF*65/75/85 LHD/RHD with ZF 6S-850, 8/9/16S-109, 8/16S-151/181/221 and Eaton FS/6309A gearboxes.

Angle A: 90°

Note:
After the gear lever has been manually positioned at an angle of 90°, the linkage mechanism should be fitted together with the selector shaft lever.



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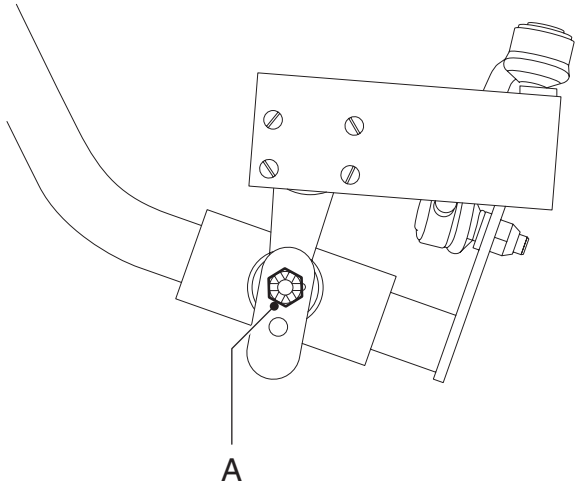
Vehicle series *CF*65 / RHD with gearbox type ZF 6S-850

If the selector shaft lever has two attachment holes, the attachment hole (A) in the selector shaft lever should be used to attach the shaft lever properly to the control rod.



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Bonding the gear lever into the ball

De-greaser	DAF No. 1322827
Glue	DAF No. 1340646

Bonding the ball joint to the control rod

De-greaser	DAF No. 1322827
Glue	DAF No. 1340646

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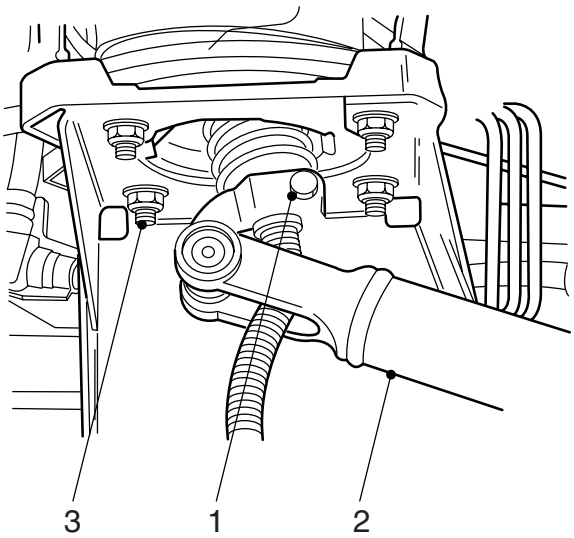
1.2 TIGHTENING TORQUES

The tightening torques stated in this section are different from the standard tightening torques included in the overview of standard tightening torques.
Any other threaded connections that are not specified must therefore be tightened to the torque stated in the overview of standard tightening torques.

When attachment bolts and nuts are to be replaced, it is important that they are of exactly the same length and property class as the ones removed unless stated otherwise.

Control rod

Fastening bolt (1) of control rod on gear lever unit	40 Nm
Attachment nuts (3), gear lever unit	27 Nm
Attachment bolt, selector shaft lever to gearbox selector housing	40 Nm



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2. PNEUMATICALLY ASSISTED GEARBOX CONTROL (SERVOSHIFT)

2.1 GENERAL

Servoshift unit

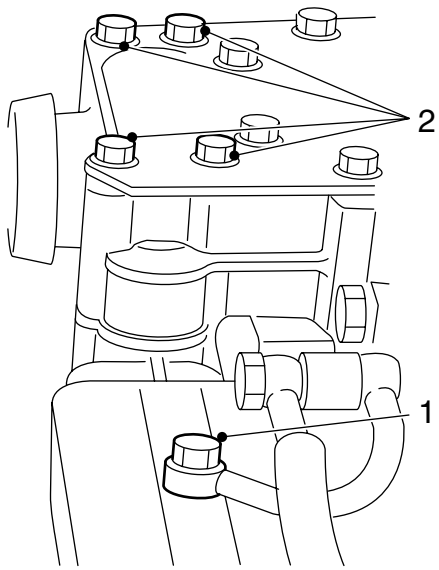
Service pressure	max. 10 bar

2.2 TIGHTENING TORQUES

The tightening torques stated in this section are different from the standard tightening torques included in the overview of standard tightening torques.
Any other threaded connections that are not specified must therefore be tightened to the torque stated in the overview of standard tightening torques.

When attachment bolts and nuts are to be replaced, it is important that they are of exactly the same length and property class as the ones removed unless stated otherwise.

Air pipe banjo bolt (1)	38 Nm
Attachment bolts:	
Servoshift unit (2)	23 Nm



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3. PNEUMATIC SECTION OF GEARBOX

3.1 GENERAL

If the vehicle is modified and the configuration changed, the electronic unit may have to be programmed.

Note:
If the vehicle's drive configuration is changed, this must always be stated. The gate protection and range-change protection frequencies programmed into the electronic unit are related to the drive configuration.

GV VALVE

GV valve begins to open (C)	123 ± 2 mm
Total clutch pedal travel (D)	154 ± 2 mm

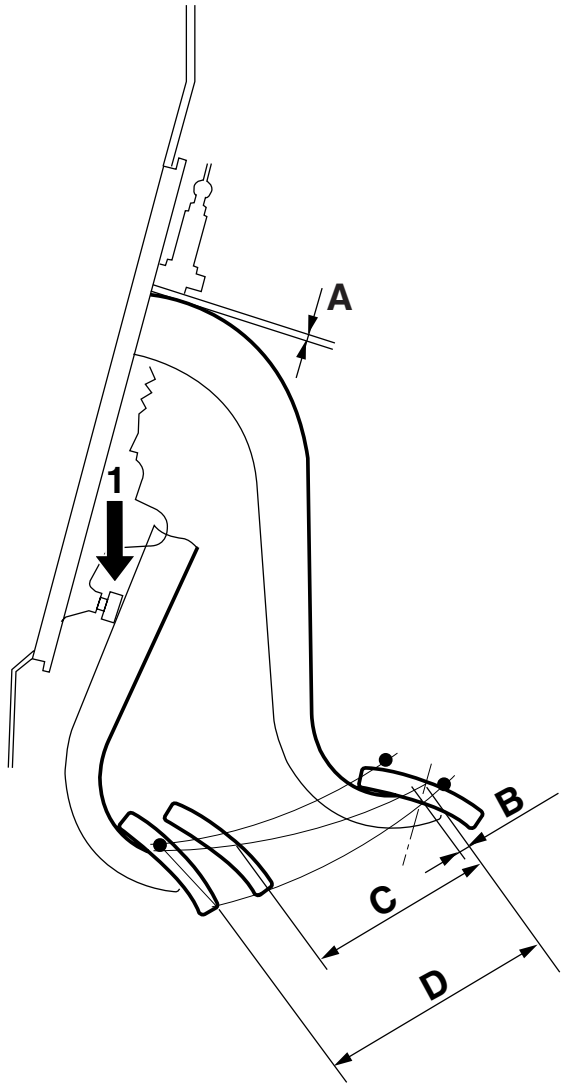
NEUTRAL POSITION VALVE

Situation with separate air distribution block:

2 x 3/2-way valve	
Service pressure	6.5 to 10 bar
Pipe connection	M14 x 1.5

Situation with integrated air distribution block:

3/2-way valve	
Service pressure	6.5 to 10 bar
Pipe connection	Not applicable



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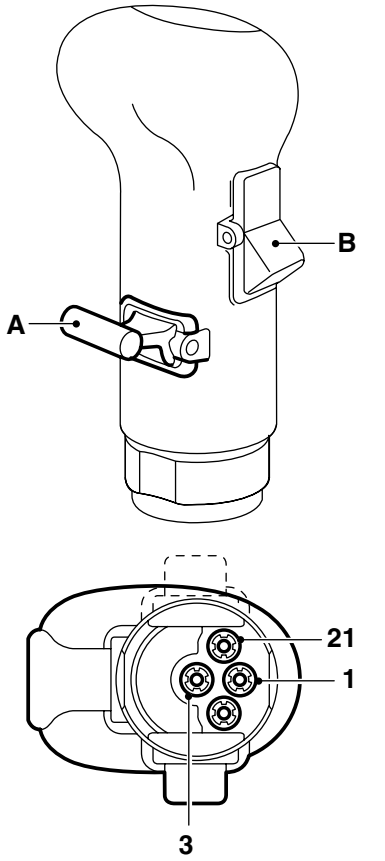
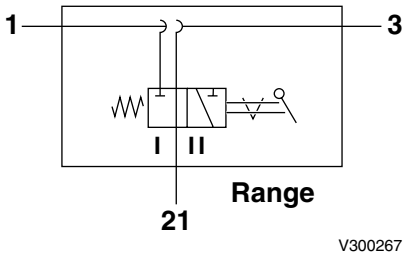
GEAR LEVER SELECTOR VALVE

Range-change gear

Connection point		Colour
1	Supply	Black
3	Bleed	Red
21	Range-change gear command (A)	White



PNEUMATIC SYMBOL



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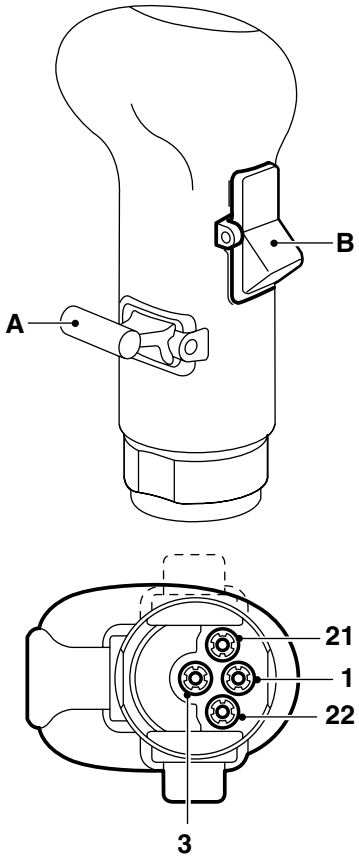
GEAR LEVER SELECTOR VALVE

Range-change gear and splitter

Connection point		Colour
1	Supply	Black
3	Bleed	Red
21	Range-change gear command (A)	White
22	Splitter command (B)	Yellow



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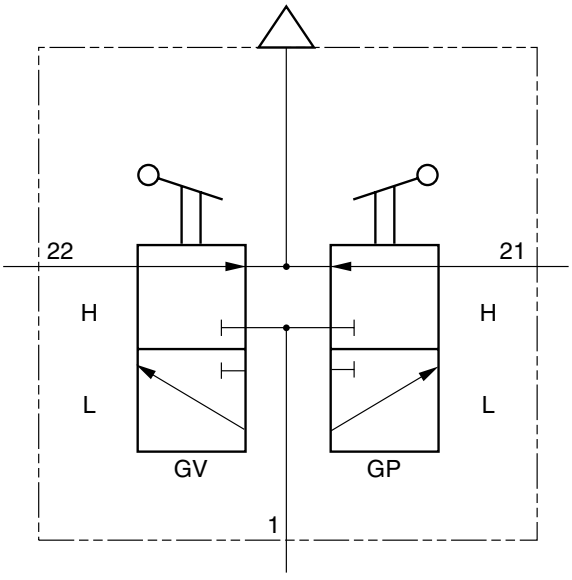
PNEUMATIC SYMBOL

Range-change gear and splitter

Position	Function
GP	Range-change gear
GV	Splitter



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3.2 TIGHTENING TORQUES

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The tightening torques stated in this section are different from the standard tightening torques included in the overview of standard tightening torques.
Any other threaded connections that are not specified must therefore be tightened to the torque stated in the overview of standard tightening torques.

When attachment bolts and nuts are to be replaced, it is important that they are of exactly the same length and property class as the ones removed unless stated otherwise.

Gear button on gear lever	
Gear button lock nut	70 Nm

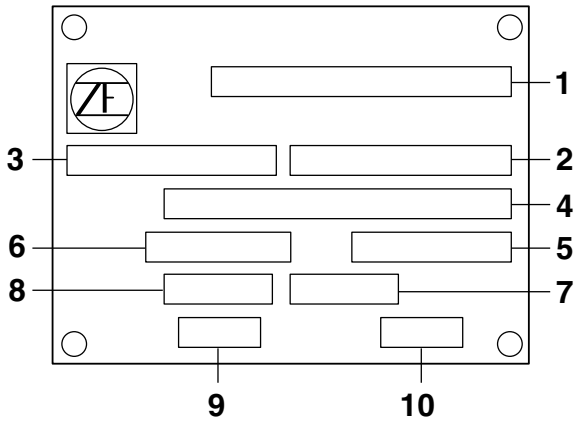
4. ZF 6S-850 GEARBOX

4.1 GENERAL

Gearbox type

Each gearbox has a type-plate attached to it, indicating the type of gearbox. This data is also stated on the identity card of the relevant vehicle.

ZF gearbox type-plate
1. Type of gearbox
2. Series no. (ZF)
3. Parts list (ZF)
4. Specification no.
5. Pulse generator ratio
6. Gearbox ratio
7. Engine speed using PTO
8. PTO speed
9. Gearbox oil capacity
10. Oil specification



V300049

Output shaft bearing axial play

Output shaft bearing axial play	0.00 - 0.10 mm

Bearing axial play, main and input shafts

Bearing axial play, main and input shafts	0.00 - 0.10 mm

Auxiliary shaft bearing axial play

Auxiliary shaft bearing axial play	0.00 - 0.10 mm

4.2 TIGHTENING TORQUES

0

The tightening torques stated in this section are different from the standard tightening torques included in the overview of standard tightening torques.
Any other threaded connections that are not specified must therefore be tightened to the torque stated in the overview of standard tightening torques.

When attachment bolts and nuts are to be replaced, it is important that they are of exactly the same length and property class as the ones removed unless stated otherwise.

Gearbox to engine	
M8 attachment bolts - 10.9	30 Nm
M10 attachment bolts - 10.9	60 Nm
M12 attachment bolts - 10.9	110 Nm
Drive flange	
Drive flange attachment bolt	
- 120 mm flange diameter	140 Nm
- 150 mm flange diameter	140 Nm
Gearbox front cover	
Attachment bolts	23 Nm
Selector shaft housing	
Attachment bolts	23 Nm
Shifting arm lock nut	46 Nm
Air connection banjo bolt	23 Nm
Bleeder	10 Nm
Plugs	
Drain plug	50 Nm
Level check/filler plug	50 Nm

4.3 FILLING CAPACITIES

Gearbox type	Filling capacities at oil change (litres)	First filling, e.g. during repair (litres)
ZF 6S-850	7.5	7.5

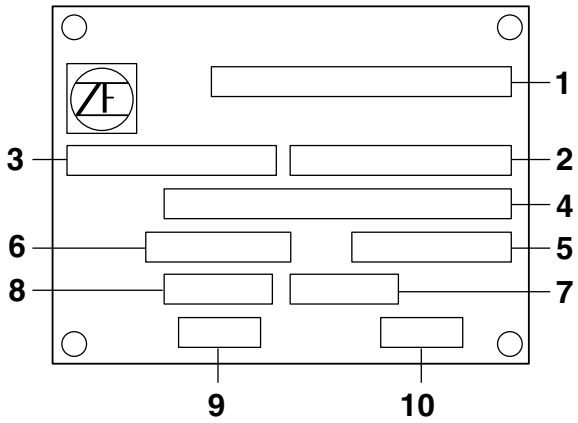
5. ZF 8/9/16S-109 GEARBOX

5.1 GENERAL

Gearbox type

Each gearbox has a type-plate attached to it, indicating the type of gearbox. This data is also stated on the identity card of the relevant vehicle.

ZF gearbox type-plate
1. Type of gearbox
2. Series no. (ZF)
3. Parts list (ZF)
4. Specification no.
5. Pulse generator ratio
6. Gearbox ratio
7. Engine speed using PTO
8. PTO speed
9. Gearbox oil capacity
10. Oil specification



V300049

Output shaft bearing axial play

Output shaft bearing axial play	0.00 - 0.10 mm

Bearing axial pre-load, main and input shafts

Bearing axial pre-load, main and input shafts	
8/9S-109	0.18 - 0.30 mm
16S-109	0.18 - 0.30 mm

Bearing axial pre-load, auxiliary shaft

Bearing axial pre-load, auxiliary shaft	
8/9S-109	0.18 - 0.30 mm
16S-109	0.18 - 0.30 mm

Retaining element

Standard spring force	168 N
Heavy-duty spring force	191 N

5.2 TIGHTENING TORQUES

0

The tightening torques stated in this section are different from the standard tightening torques included in the overview of standard tightening torques.
Any other threaded connections that are not specified must therefore be tightened to the torque stated in the overview of standard tightening torques.

When attachment bolts and nuts are to be replaced, it is important that they are of exactly the same length and property class as the ones removed unless stated otherwise.

Gearbox to engine	
M8 attachment bolts - 10.9	30 Nm
M10 attachment bolts - 10.9	60 Nm
M12 attachment bolts - 10.9	110 Nm
Drive flange	
Retaining plate attachment bolts	60 Nm
Gearbox front cover	
Attachment bolts	25 Nm
Bearing cover	
Output shaft bearing cover	25 Nm
Control bearing cover	25 Nm
Air connection banjo bolt	38 Nm
Shift control high/low	
Shifting fork high/low bolts	180 Nm
Gear engaging cylinder piston lock nut	180 Nm
Gear engaging cylinder attachment bolts	50 Nm
Air connection banjo bolt	38 Nm
Rear gearbox cover attachment bolts	50 Nm
Plugs	
M24 drain plug	60 Nm
M38 drain plug	120 Nm
Level check/filler plug	60 Nm

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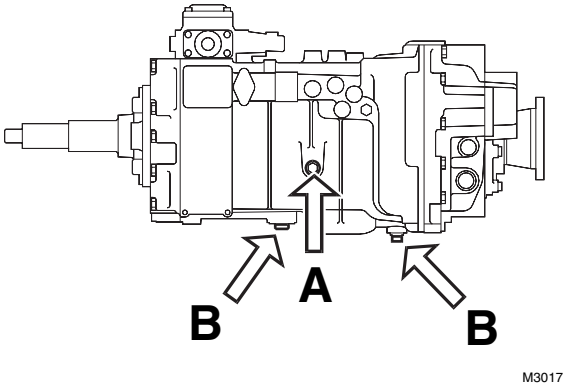
Plugs

Gearbox with integrated intarder		
Drain plug (B)	M24	60 Nm
Drain plug (B)	M38	120 Nm
Drain plug (C)		60 Nm
Level check/filler plug (A).		60 Nm
Oil filter attachment bolt (1)		23 Nm



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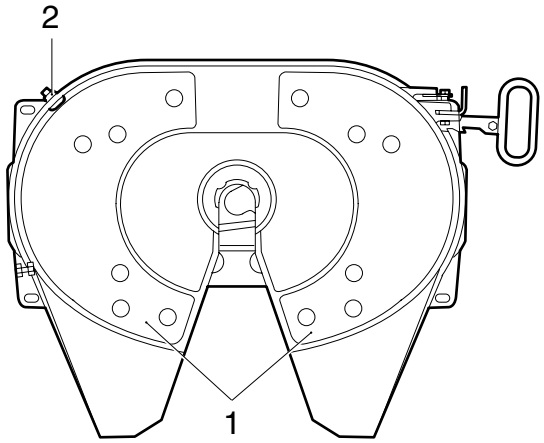

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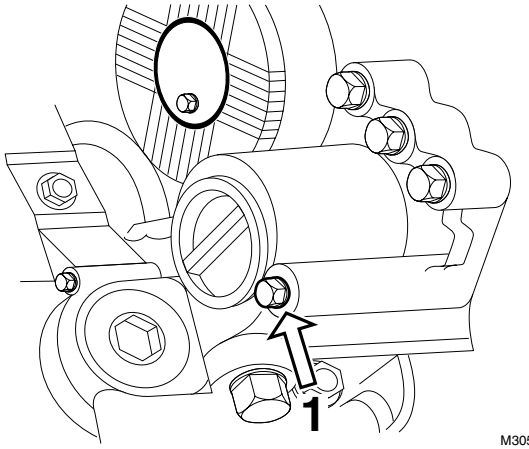

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5.3 FILLING CAPACITIES

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Filling amounts, ZF gearboxes without intarder

Gearbox type	Filling amounts at oil change (litres)	First filling, e.g. during repair (litres)
ZF 8/16S-109	9	9.5
ZF 9/S-109	8	8.5

Filling amounts, ZF gearboxes with integrated intarder

Gearbox type	Filling amounts at oil change (litres)	First filling, e.g. during repair (litres)
ZF 8/16S-109	12.5	22
ZF 9S-109	12	21

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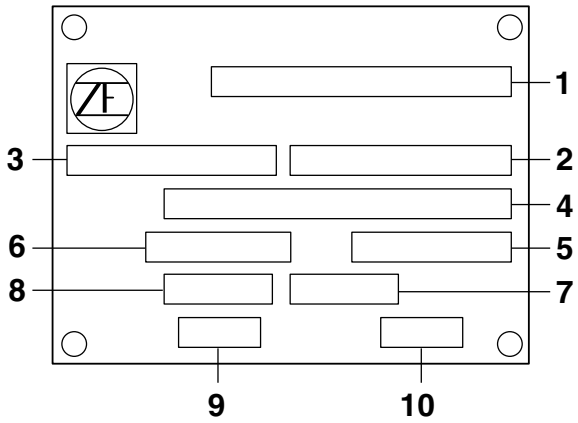
6. ZF 8/16S-151/181 AND 16S-221 GEARBOXES

6.1 GENERAL

Gearbox type

Each gearbox has a type-plate attached to it, indicating the type of gearbox. This data is also stated on the identity card of the relevant vehicle.

ZF gearbox type-plate
1. Type of gearbox
2. Series no. (ZF)
3. Parts list (ZF)
4. Specification no.
5. Pulse generator ratio
6. Gearbox ratio
7. Engine speed using PTO
8. PTO speed
9. Gearbox oil capacity
10. Oil specification



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Output shaft bearing axial play

Output shaft bearing axial play	0.00 - 0.10 mm

Bearing axial play, main and input shafts

Bearing axial play, main and input shafts	0.00 - 0.10 mm

Auxiliary shaft bearing axial play

Auxiliary shaft bearing axial play	0.00 - 0.10 mm

Retaining element

Standard spring force	168 N
Heavy-duty spring force	191 N

6.2 TIGHTENING TORQUES

0

The tightening torques stated in this section are different from the standard tightening torques included in the overview of standard tightening torques.
Any other threaded connections that are not specified must therefore be tightened to the torque stated in the overview of standard tightening torques.

When attachment bolts and nuts are to be replaced, it is important that they are of exactly the same length and property class as the ones removed unless stated otherwise.

Gearbox to engine	
M8 attachment bolts - 10.9	30 Nm
M10 attachment bolts - 10.9	60 Nm
M12 attachment bolts - 10.9	110 Nm
Drive flange	
M12 x 70 drive flange - 8.8	60 Nm
M12 x 60 drive flange - 10.9	120 Nm
M12 x 70 drive flange - 10.9	120 Nm
M12 x 165 drive flange - 10.9	120 Nm
Gearbox front cover	
Attachment bolts	46 Nm
Bearing cover	
Output shaft bearing cover	49 Nm
Control bearing cover	23 Nm
Shift control high/low	
Shifting fork high/low bolts	180 Nm
Gear engaging cylinder piston lock nut	180 Nm
Gear engaging cylinder attachment bolts	50 Nm
Air connection banjo bolt	38 Nm
Rear gearbox cover attachment bolts	50 Nm
Plugs	
M24 drain plug	60 Nm
M38 drain plug	120 Nm
Level check/filler plug	60 Nm

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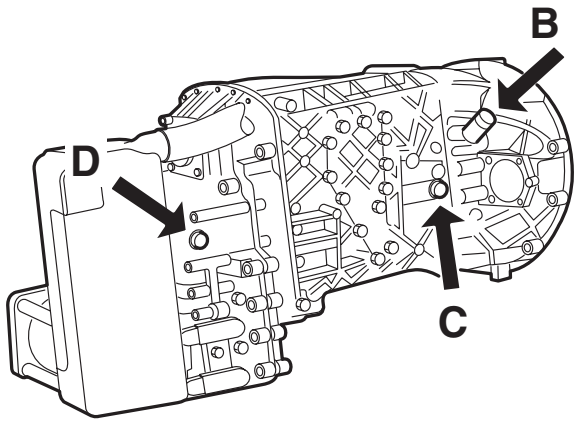
Plugs

Gearbox with integrated intarder		
Drain plug (B)	M24	60 Nm
Drain plug (B)	M38	120 Nm
Drain plug (D)		60 Nm
Level check/filler plug (4)		60 Nm
Filler plug (5)		60 Nm
Oil filter attachment bolt (1)		23 Nm



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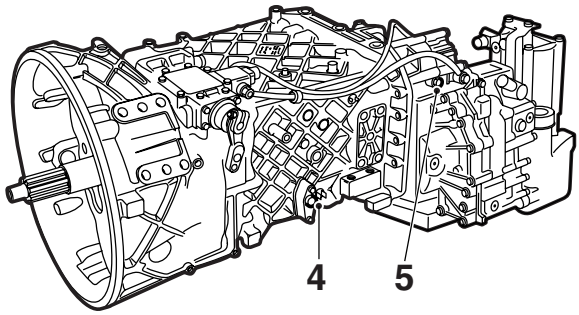

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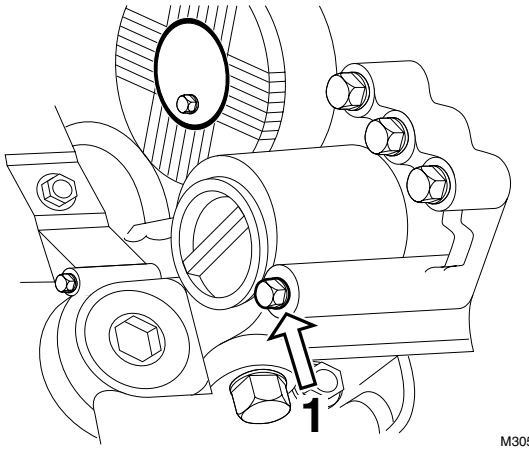

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6.3 FILLING CAPACITIES

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Filling amounts, ZF gearboxes without intarder

Gearbox type	Filling amounts at oil change (litres)	First filling, e.g. during repair (litres)
ZF 8/16S-151	11	11
ZF 8/16S-181	13	13
ZF 16S-221	13	13

Filling amounts, ZF gearboxes with integrated intarder

Gearbox type	Filling amounts at oil change (litres)	First filling, e.g. during repair (litres)
ZF 8/16S-151	11	18.5
ZF 8/16S-181	12	21.5
ZF 16S-221	12	21.5

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7. EATON FS/6309A GEARBOX

7.1 GENERAL

Gearbox type
Each gearbox has a type-plate attached to it, indicating the type of gearbox. This data is also stated on the identity card of the relevant vehicle.

Eaton gearbox type-plate
1. Type of gearbox
2. Specification no. Eaton
3. DAF article Eaton code
4. Series no. Eaton
5. Production date code

The Eaton specification number is unique for each customer and gives detailed information on the development level of the gearbox.
The number must be quoted whenever replacement parts are ordered.

Input shaft play adjusting rings:	**Colour coding:**
3.70 mm	Red, green, white
3.75 mm	Yellow, green, blue
3.80 mm	Blue, green, white
3.85 mm	Red, green, yellow
3.90 mm	Green, green, white
3.95 mm	Red, green, red

Secondary shaft pre-load	
New bearings	0.075 - 0.125 mm
Original bearings	0.000 - 0.050 mm
Sealant	
Sealing compound for seal contact surfaces of drive flange oil seal housing	Loctite 518
Input shaft	Lithium-based grease, class NLGI 3
Filter/governor	
Governed pressure	5.3 - 5.7 bar

7.2 TIGHTENING TORQUES

0

The tightening torques stated in this section are different from the standard tightening torques included in the overview of standard tightening torques.
Any other threaded connections that are not specified must therefore be tightened to the torque stated in the overview of standard tightening torques.

When attachment bolts and nuts are to be replaced, it is important that they are of exactly the same length and property class as the ones removed unless stated otherwise.

Drive flange	
M39 drive flange nut	650 Nm(1)
Drive flange oil seal housing attachment bolts	60 Nm
Gearbox front cover	
Attachment bolts	37 Nm
Selector shaft housing	
Selector shaft housing attachment bolts	37 Nm(2)
Retaining cover attachment bolts	22 Nm
M8 shifting arm lock nut	25 Nm
M8 shifting arm lock nut	25 Nm
End cover attachment bolts	22 Nm
Bleed valve	
Attachment bolts	19 Nm
Bearing cover	
Output shaft bearing cover	25 Nm
Air connection banjo bolt	38 Nm
Filter/governor	
M6 attachment bolts	13 Nm
Cover	25 Nm
Selector valve	
M6 attachment bolts	22 Nm
M16 discharge valve attachment bolts	19 Nm
M8 cover plate attachment bolts	22 Nm
Range-change cylinder	
M8 cover plate attachment bolts	17 Nm
M16 nut on piston	105 Nm

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Plugs

Drain plug	50 Nm
Level check/filler plug	50 Nm

(1) Use new nut
(2) Loctite 243

7.3 FILLING CAPACITIES

Gearbox capacity

Type	Contents
FS/6309A	8.5 litres

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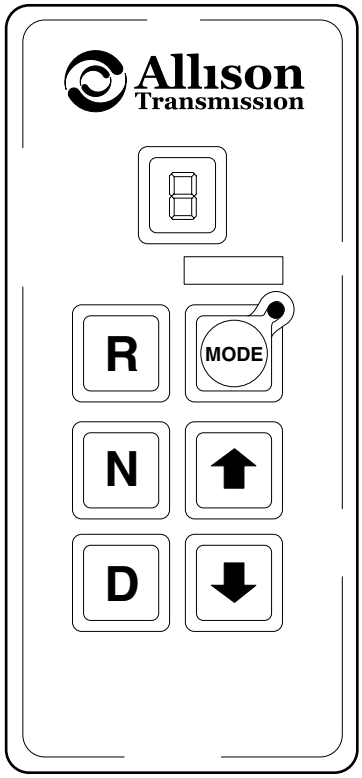
8. ALLISON AUTOMATIC GEARBOX

8.1 GENERAL

Allison transmission, used in the *CF*65/75, is electronically controlled and has its own diagnostic system that saves any faults in the memory of the ECU (Electronic Control Unit). The faults can be read at a later date. The system is operated and the faults are read via the selector keypad. The “Selector keypad” fitted with a display is located next to the driver’s seat and replaces the gear lever with manual stick-shift gearboxes.



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8.2 TIGHTENING TORQUES

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The tightening torques stated in this section are different from the standard tightening torques included in the overview of standard tightening torques.
Any other threaded connections that are not specified must therefore be tightened to the torque stated in the overview of standard tightening torques.

When attachment bolts and nuts are to be replaced, it is important that they are of exactly the same length and property class as the ones removed unless stated otherwise.

Gearbox bleeder	14 Nm
M14 x 2.0 drive flange attachment bolt	75 Nm
Gearbox rear mounting bracket	100 Nm
PTO bracket	55 Nm
Gearbox with flywheel housing adapter, M10 x 1.5	55 Nm
Flex plates to flex plate adapter	
CF65	68 Nm
CF75	34 Nm
Flex plate adapter to torque converter	34 Nm
Hydraulic pipes to oil cooler	60 Nm
Gearbox main connector	2.5 Nm
Attachment bolts for oil filter caps	55 Nm
Oil drain plugs	28 Nm
Coolant pipe attachment	55 Nm
Molycote for the top bearing of the torque converter on installation	BR2S or BR2 Plus

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8.3 FILLING CAPACITIES

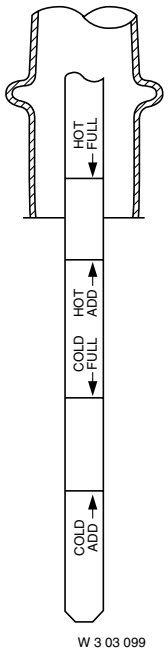
Allison automatic gearbox oil capacities

Type of gearbox	Capacity at first filling	Capacity at second filling
MD 3060P 4″ oil sump	27 litres	20 litres
MD 3066P 4″ oil sump	27 litres	20 litres
MD 3560P 4″ oil sump	27 litres	20 litres

The oil level when cold must be on the “Cold full” mark.

Dip-stick readings:

- “Cold add” = add when cold
- “Cold full” = full when cold
- “Hot add” = add when hot
- “Hot full” = full when hot



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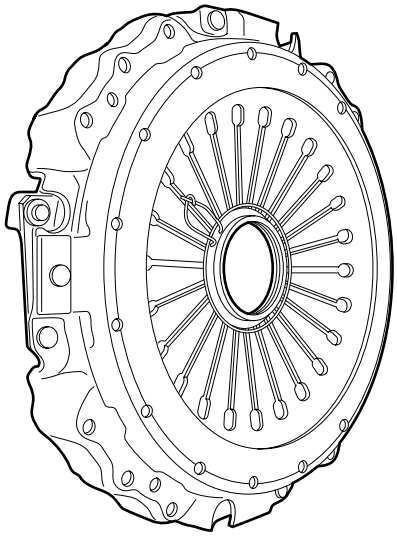
9. CLUTCH

9.1 GENERAL

CLUTCH RELEASE ASSEMBLIES



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Clutch release assembly

Engine type	Clutch release assembly type	Note
CE	MF 395 MF 395 with extended service life	Automatically adjusting clutch release assembly and wear indicator
PE	MF 395 MF 395 with extended service life MFZ 430 MFZ 430 with extended service life	Automatically adjusting clutch release assembly Automatically adjusting clutch release assembly and wear indicator
XE	MFZ 430 MFZ 430 with extended service life	Automatically adjusting clutch release assembly and wear indicator

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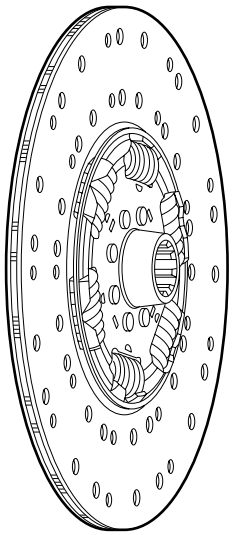
CLUTCH PLATE



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Clutch plate

Engine type	Clutch plate	Lining thickness (mm)	Splines	Thrust bearing
CE	395 WGTZ 395 WGTZ 395 WGTZ 395 WGTZ	3 3 5 5	1.5″ 1.75″ 1.5″ 1.75″	KZI-4 KZI-4 KZI-4 KZI-4
PE	395 WGTZ 395 WGTZ 430 GTZ 430 GTZ	3 5 3 5	1.75″ 1.75″ 2″ 2″	KZI-4 KZI-4 KZIZ-5 KZIZ-5
XE	430 GTZ 430 GTZ	3 5	2″ 2″	KZIZ-5 KZIZ-5

Note:
All clutch plates are single dry plate versions and have a lining of the Valeo-Raybestos B9605 asbestos-free type.
The AS Tronic gearbox is fitted with a clutch plate with the following type of lining: Valeo F202 asbestos-free.

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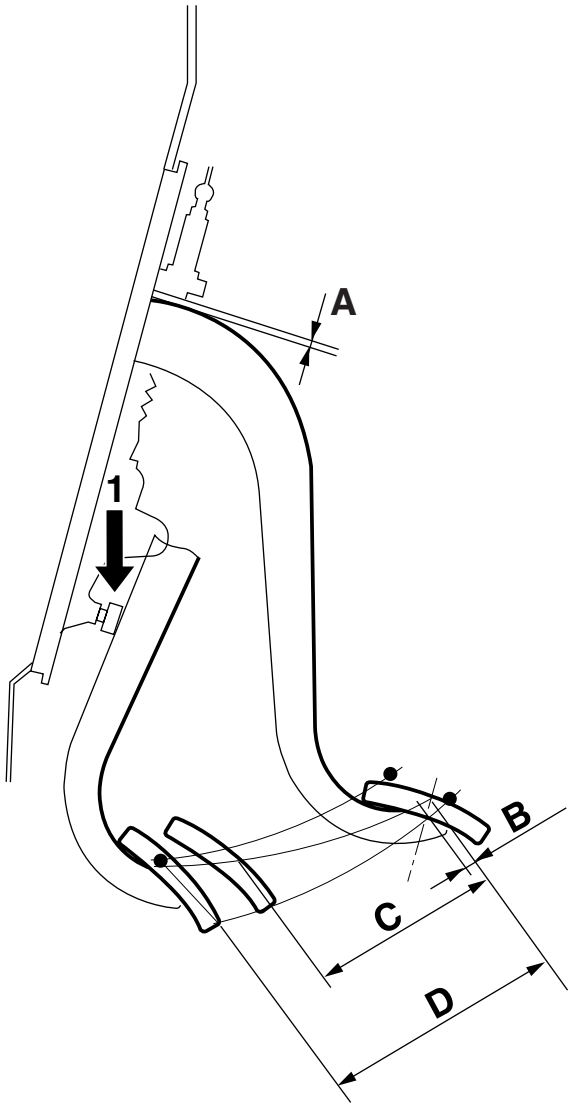
Clutch pedal

Clutch pedal proximity sensor (A)	1 - 0 + 1 mm
Clutch pedal free travel (B)	approx. 2 - 4 mm
GV valve begins to open (C)	123 ± 2 mm
Total clutch pedal travel (D)	154 ± 2 mm



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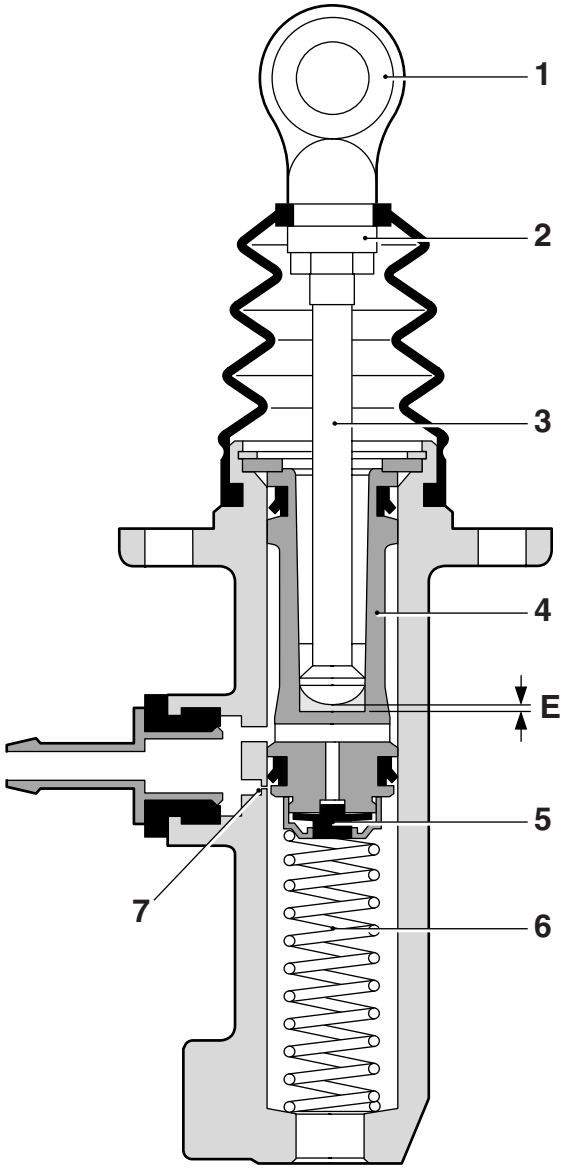
Main cylinder

Maximum piston stroke	34 mm
Pressure pin setting (E)	approx. 0.2 - 0.8 mm
Mounting seals	Silicone grease



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9.2 TIGHTENING TORQUES

The tightening torques stated in this section are different from the standard tightening torques included in the overview of standard tightening torques.
Any other threaded connections that are not specified must therefore be tightened to the torque stated in the overview of standard tightening torques.

When attachment bolts and nuts are to be replaced, it is important that they are of exactly the same length and property class as the ones removed unless stated otherwise.

Main cylinder	
Pressure pin attachment nut	55 Nm
Bleeder	8 Nm
Steel pipe coupling	40 Nm
Clutch release assembly	
ZF gearboxes	
Attachment bolts, clutch release assembly to flywheel	54 Nm
Attachment bolt, automatically adjusting clutch release assembly stop plate	39 Nm(1)

(1) Loctite 648

ZF 6S-850	
Attachment bolts, clutch release assembly to flywheel	54 Nm
Attachment bolts, clutch lever to gearbox	27 Nm
8/9/16S-109	
M16 round bolt, clutch lever to clutch housing	90 Nm
8/16S-151/181/221	
M8 attachment bolts, clutch lever to gearbox	30 Nm
EATON FS/6309A gearbox	
Attachment bolts, clutch release assembly to flywheel	54 Nm
Attachment bolts, clutch lever to gearbox	27 Nm

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AS TRONIC gearbox	
M12 attachment bolts, clutch lever to gearbox	79 Nm
AS TRONIC clutch unit	
Clutch unit attachment nut	23 Nm
Clutch unit stud	10 Nm
Bleed screw, clutch unit	22 Nm
Compressed air connection	50 Nm

9.3 FILLING CAPACITIES

Clutch operating unit	
First filling	± 0.4 litres

10. PROP SHAFTS

10.1 GENERAL

For the *CF* 65/75/85 vehicle series, DAF has one manufacturer of prop shafts, Klein. Klein shafts can be identified by their highly bevelled flanges.

Inspection
There must be no clearly noticeable play on universal joints, centre bearing or sliding clutch.

Universal joint radial play	0.01 - 0.05 mm
Maximum permissible axial play of universal joints	0.3 mm

***CF*65**

Balancing speed (∅ 85 x 5 mm)		
retracted length	≤ 1750 mm	max. n = 3000 $n/_{min}$
Length of idler shaft	≤ 1950 mm	

***CF*75**

Balancing speed (∅ 120 x 3 mm)		
retracted length	≤ 2120 mm	max. n = 3000 $n/_{min}$
Length of idler shaft	≤ 2340 mm	

***CF*85**

Balancing speed (∅ 120 x 5 mm)		
retracted length	≤ 2120 mm	max. n = 3000 $n/_{min}$
Length of idler shaft	≤ 2340 mm	
Balanceertoerental (∅ 140 x 5 mm)		
retracted length	≤ 2320 mm	max. n = 3000 $n/_{min}$
Length of idler shaft	≤ 2500 mm	

Centre bearings
If a lubricating nipple is fitted to the *CF*65/75/85, it must be lubricated.

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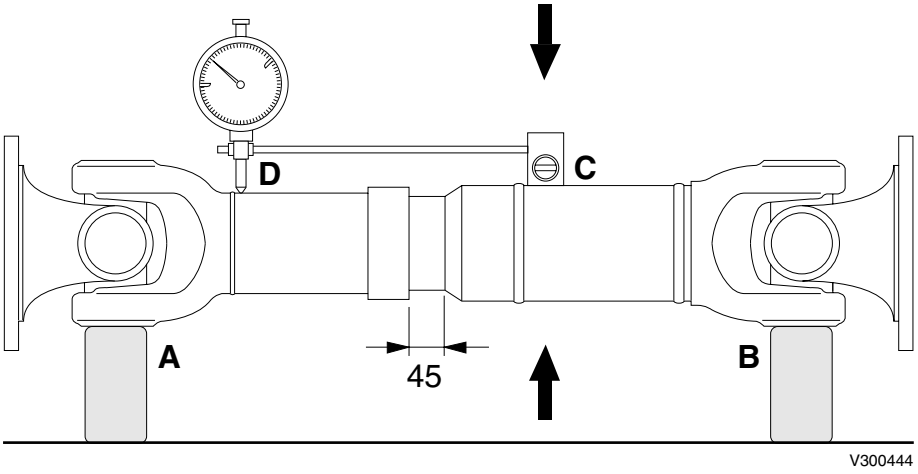
Maximum permissible axial play of slide joint	0.25 mm



10.2 TIGHTENING TORQUES

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Any other threaded connections that are not specified must therefore be tightened to the torque stated in the overview of standard tightening torques.

When attachment bolts and nuts are to be replaced, it is important that they are of exactly the same length and property class as the ones removed unless stated otherwise.

Attachment bolts, drive flanges	
M12 - 10.9	110 Nm
M14 - 10.9	170 Nm
Centre bearing central nut	
M24 x 1.5	250 Nm
M40 x 1.5	350 Nm
M55 x 1.5	380 Nm
Centre bearing attachment bolts	170 Nm(1)

(1) Loctite 243

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10.3 FILLING CAPACITIES

Note:
All prop shafts are maintenance-free, although vehicles that are used in heavy conditions are fitted as standard with lubricating nipples on the universal joints.

Clean grease must emerge visibly from all four needle sleeve seals of the spider during greasing.

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11. ZF INTARDER

11.1 GENERAL

Axial play	
Stator	0 ± 0.05 mm
Output shaft bearing	0 - 0.1 mm
Oil pump external rotor	0.03 - 0.05 mm
Intarder drive sprocket	
Heat in oven for a maximum of 15 minutes	130° - 150°C

11.2 TIGHTENING TORQUES

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When attachment bolts and nuts are to be replaced, it is important that they are of exactly the same length and property class as the ones removed unless stated otherwise.

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Drive flange attachment bolts	
Attachment bolts (8.8)	60 Nm
Attachment bolts (10.9)	120 Nm
Shift control high/low	
Shifting fork high/low bolts	180 Nm
Gear engaging cylinder piston lock nut	180 Nm
Gear engaging cylinder attachment bolts	50 Nm
Air connection banjo bolt	38 Nm
Attachment bolts	
rear gearbox cover	50 Nm
Heat exchanger	
Studs in heat exchanger	18 Nm(1)
Attachment nuts	62 Nm(1)
Oil connection flange attachment bolt	23 Nm(1)
Heat exchanger attachment surfaces	Loctite 574
Hydraulic control unit	
M10 attachment bolts	50 Nm
Sensors and transmitters	
Temperature transmitter	40 Nm
Air supply valve	23 Nm
Proportional valve	23 Nm
Intarder attachment to gearbox	
M10 attachment bolts	50 Nm
Oil pump	
Attachment bolts	23 Nm
Oil filter	
Attachment bolt	23 Nm

(1) Secure with Loctite 574

12. PTO

12.1 GENERAL

For the *CF*65/75/85 vehicle series, DAF has two sorts of PTO:
the DAF engine PTO and the
ZF/Eaton gearbox PTOs.
The DAF engine PTO can be recognised by the position of the PTO, i.e. on top of the flywheel housing. The ZF/Eaton PTOs can be recognised by the position at the rear of the gearbox.

DAF ENGINE PTO

Axial play	
Drive gears between crankshaft and PTO	0.15 - 0.30 mm
PTO housing prop shaft bearings	0.02 - 0.1 mm

ZF GEARBOX PTO

Bearing axial play

Axial play on gearbox output shaft, in case of attachment of N 211/10 PTO on gearbox without intarder	0 - 0.1 mm
Axial play in case of attachment of NL/1 PTO on N211/10 PTO	0 - 0.2 mm

12.2 TIGHTENING TORQUES

0

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Any other threaded connections that are not specified must therefore be tightened to the torque stated in the overview of standard tightening torques.

When attachment bolts and nuts are to be replaced, it is important that they are of exactly the same length and property class as the ones removed unless stated otherwise.

DAF ENGINE PTO

Main shaft lock nut	500 Nm(1)
Gear attachment bolt in flywheel housing	110 Nm
Sealing plate at rear of flywheel housing	30 Nm
Output shaft flange bolt	110 Nm
Gear shift lever	30 Nm
PTO operating cylinder cover	30 Nm
Operating cylinder housing expansion plug	Loctite 510
Attachment bolts, shift control on gearbox	30 Nm
PTO gearbox stud	68 Nm(1)
Attachment nut, drive housing stud	68 Nm(1)
Attachment, PTO housing to flywheel housing	Loctite 510
Attachment bolt, PTO housing to flywheel housing	40 Nm
Oil pipe banjo bolts	50 Nm

ZF GEARBOX PTO

Attachment NH/1-/4 and NL/1-/4

Install attachment studs with a liquid gasket	25 Nm
Nuts for fastening attachment to gearbox	86 Nm

Attachment NH/1-/4 and NL/1-/4 on AS Tronic gearbox

Install attachment studs with a liquid gasket	18 Nm
Nuts for fastening attachment to gearbox	65 Nm

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Attachment N221/10

Drive flange	120 Nm
Side cover attachment bolts	23 Nm
Bolts for fastening attachment to gearbox	79 Nm

Attachment N AS/10

Drive flange	120 Nm
Side cover attachment bolts	23 Nm
Bolts for fastening attachment to gearbox	79 Nm

(1) Secure with Loctite 243

EATON GEARBOX PTO

Attachment Z81

Drive flange attachment bolt	100 ± 5 Nm
Install attachment studs with a liquid gasket	28 Nm
Nuts for fastening attachment to gearbox	65 Nm

Attachment 2266

Drive flange attachment bolt	100 ± 5 Nm
Drive shaft cover attachment bolts	75 ± 4 Nm
Bolts for fastening attachment to gearbox	50 ± 2.5 Nm

12.3 FILLING CAPACITIES

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Extra filling capacities, ZF gearbox PTOs

PTO TYPE	FILLING CAPACITY (l)
NH/1B	0.2
NL/1B	0.2
NH/1C	0.2
NL/1C	0.2
NH/4B	0.5
NL/4B	0.5
NH/4C	0.5
NL/4C	0.5
N221/10B	1.0
N221/10C	1.0
N221/10 IT	1.0
N221/10 C IT	1.0
N221/10 B PL	1.0
N221/10 C-PL	1.0
N AS/10 B	1.0
N AS/10 B IT	1.0
N AS/10 C	1.0
N AS/10 C IT	1.0
N AS/10 B+C	1.0
N AS/10 B+C IT	1.0

Extra filling capacities, EATON gearbox PTO

PTO TYPE	FILLING CAPACITY (l)
2266	0.25

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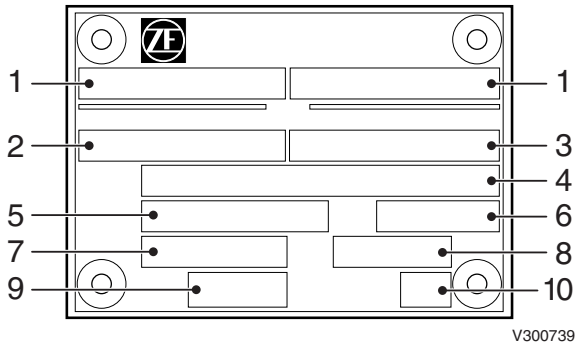
13. AS TRONIC GEARBOX

13.1 GENERAL

Gearbox type
Each gearbox has a type-plate attached to it, indicating the type of gearbox. This data is also stated on the identity card of the relevant vehicle.

ZF gearbox type-plate
1. Type of gearbox
2. Series no. (ZF)
3. Parts list (ZF)
4. Specification no.
5. Pulse generator ratio
6. Gearbox ratio
7. Engine speed using PTO
8. PTO speed
9. Gearbox oil capacity
10. Oil specification



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Output shaft bearing axial play

Output shaft bearing axial play	0 - 0.1 mm

13.2 TIGHTENING TORQUES

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Any other threaded connections that are not specified must therefore be tightened to the torque stated in the overview of standard tightening torques.

When attachment bolts and nuts are to be replaced, it is important that they are of exactly the same length and property class as the ones removed unless stated otherwise.

Gearbox to engine	
M8 attachment bolts - 10.9	30 Nm
M10 attachment bolts - 10.9	60 Nm
M12 attachment bolts - 10.9	110 Nm
Drive flange	
Attachment bolts	120 Nm
Gearbox front cover	
Attachment bolts	23 Nm
Sealant	Loctite 574
Bearing cover	
Attachment bolts, output shaft bearing cover	46 Nm
Sealant, output shaft bearing cover	Loctite 574
Gearbox modulator	
Attachment bolts	23 Nm
Bleeder	10 Nm
Clutch unit	
Bleed screw	22 Nm
Compressed air connection	50 Nm

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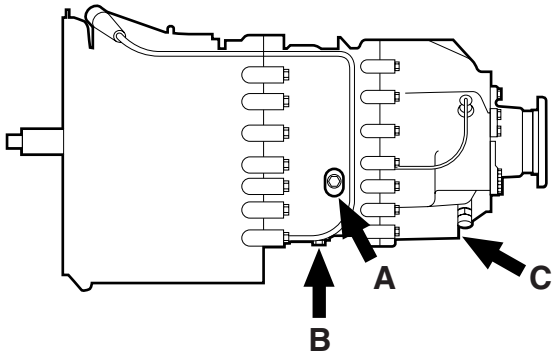
Plugs

AS Tronic

Drain plug (B, C)	60 Nm
Level check/filler plug (A).	60 Nm



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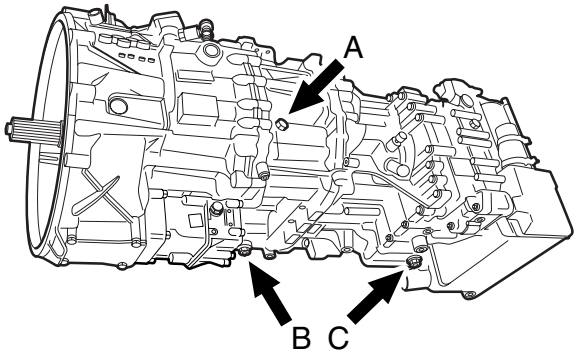
AS Tronic with intarder

Drain plug (B, C)	60 Nm
Level check/filler plug (A).	60 Nm



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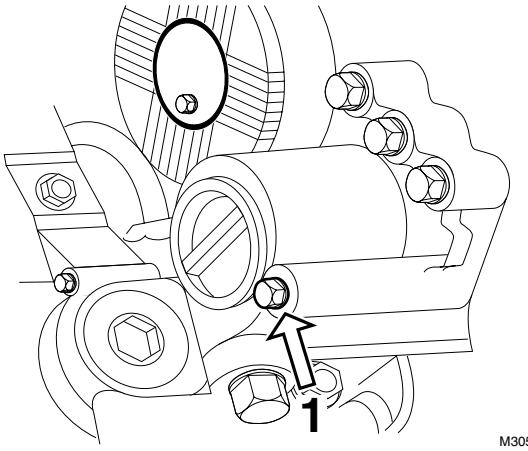
Oil filter attachment bolt (1)	23 Nm



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13.3 FILLING CAPACITIES

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Filling amounts, ZF gearboxes without intarder

Gearbox type	Filling amounts at oil change (litres)	First filling, e.g. during repair (litres)
ZF 12 AS 1930 TD	11	11
ZF 12 AS 2330 TO	11	11
ZF 12 AS 2540 TD	12	12

Filling amounts, ZF gearboxes with integrated intarder

Gearbox type	Filling amounts at oil change (litres)	First filling, e.g. during repair (litres)
ZF 12 AS 1931 TD	12	21
ZF 12 AS 2331 TO	12	21
ZF 12 AS 2541 TD	13	23

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CONTENTS

		Page	Date
1.	**MECHANICAL GEARBOX CONTROL**	1-1	200337
1.1	Fault-finding table	1-1	200337
2.	**PNEUMATICALLY ASSISTED GEARBOX CONTROL (SERVOSHIFT)**	2-1	200337
2.1	Fault-finding table	2-1	200337
3.	**PNEUMATIC SECTION OF GEARBOX**	3-1	200337
3.1	Fault-finding table	3-1	200337
4.	**MECHANICAL GEARBOX**	4-1	200337
4.1	Fault-finding table	4-1	200337
5.	**AUTOMATIC GEARBOX**	5-1	200337
5.1	Reading/deleting fault codes	5-1	200337
5.2	Table of fault codes	5-3	200337
6.	**CLUTCH**	6-1	200337
6.1	Fault-finding table	6-1	200337
7.	**PROP SHAFTS**	7-1	200337
7.1	Fault-finding table	7-1	200337
8.	**ZF INTARDER**	8-1	200337
8.1	Fault-finding table	8-1	200337
9.	**AS TRONIC**	9-1	200337
9.1	Fault-finding table	9-1	200337

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1. MECHANICAL GEARBOX CONTROL

1.1 FAULT-FINDING TABLE

SYMPTOM: GEAR LEVER VIBRATES	
Possible cause	**Remedy**
Excessive play at control hinge points	Check/repair all points in the control

SYMPTOM: ENGAGING GEARS IS HEAVY	
Possible cause	**Remedy**
Gearbox control pivot and hinge points dry or compressed	Check/repair all points in the control
Mechanical problem in gearbox	See “Mechanical gearbox” fault-finding table
Clutch does not release properly	Check clutch operating unit

SYMPTOM: GEARS CANNOT BE ENGAGED	
Possible cause	**Remedy**
Gearbox control pivot and hinge points dry or compressed	Check/repair all points in the control
Mechanical problem in gearbox	See “Mechanical gearbox” fault-finding table

SYMPTOM: GEARBOX JUMPS OUT OF GEAR	
Possible cause	**Remedy**
Incorrect adjustment of control	Check/adjust all points in the control
Mechanical problem in gearbox	See “Mechanical gearbox” fault-finding table

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2. PNEUMATICALLY ASSISTED GEARBOX CONTROL (SERVOSHIFT)

2.1 FAULT-FINDING TABLE

SYMPTOM: ENGAGING GEARS IS HEAVY	
Possible cause	**Remedy**
Servoshift unit inoperative	Inspect air pipes
Servoshift unit leaking air internally	Check air seals in unit
Mechanical problem	See “Mechanical gearbox control” and “Mechanical gearbox” fault-finding tables

SYMPTOM: GEARBOX JUMPS OUT OF GEAR	
Possible cause	**Remedy**
Selector valve in Servoshift unit defective	Replace Servoshift unit
Mechanical problem	See “Mechanical gearbox control” and “Mechanical gearbox” fault-finding tables

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3. PNEUMATIC SECTION OF GEARBOX

3.1 FAULT-FINDING TABLE

SYMPTOM: NOT POSSIBLE TO ENGAGE HIGH OR LOW RANGE	
Possible cause	**Remedy**
Air pressure too low	Check air supply of circuit 4
Neutral position valve defective or incorrectly connected	Connect valve properly or replace
Defective downshift protection valve	Replace valve
Defective high/low range engaging cylinder	Check cylinder and replace if necessary

SYMPTOM: HIGH/LOW RANGE ENGAGING CYLINDER ENGAGES AT TOO HIGH A SPEED	
Possible cause	**Remedy**
Incorrectly programmed VIC	Report the incorrect or altered configuration

SYMPTOM: HIGH OR LOW RANGE ENGAGING IS SLOW	
Possible cause	**Remedy**
Air pressure too low	Check air supply of circuit 4
Pipes blocked	Check pipes and clean if necessary
Defective neutral position valve	Replace valve

SYMPTOM: THE HIGH/LOW GROUP ENGAGING WORKS IN REVERSE	
Possible cause	**Remedy**
Air pipes on the high/low range engaging cylinder are incorrectly connected	Connect engaging cylinder air pipes correctly

SYMPTOM: NOT POSSIBLE TO ENGAGE LOW RANGE	
Possible cause	**Remedy**
No power supply to the downshift protection valve	Check the wiring
Incorrect vehicle speed signal	Check vehicle speed signal
Faulty VIC electronic unit	Replace VIC if necessary

1

SYMPTOM: SPLITTING NOT POSSIBLE	
Possible cause	**Remedy**
Air pressure too low	Check pneumatic system
Defective or incorrectly set GV valve	Check valve and adjust/replace as necessary
Wrong relay valve fitted for splitter	Fit correct relay valve type
Broken or incorrectly connected air pipes	Check air pipes and replace or connect properly, if necessary
Wrong selector switch on gear lever	Fit correct switch type
Wrong bore hole plugged in splitter cylinder	Plug correct bore hole
Splitter cylinder not working	Check cylinder and replace if necessary

SYMPTOM: SPLITTER CYLINDER OPERATES IN REVERSE MODE	
Possible cause	**Remedy**
Wrong splitter relay valve fitted	Fit correct relay valve type
Wrong gear lever selector valve fitted	Fit correct selector valve type
Air pipes connected incorrectly	Check air connections and correct as necessary

SYMPTOM: SPLITTING IS SLOW	
Possible cause	**Remedy**
Air pressure too low	Check pneumatic system
Blocked air pipes	Check pipes
Defective or incorrectly set GV valve	Check valve and adjust as necessary

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SYMPTOM: GATE 1/2 NOT SAFEGUARDED	
Possible cause	**Remedy**
No power supply to the gate protection valve	Check the wiring
Defective gate protection valve (B293)	Replace the gate protection valve
VIC does not receive a speed signal or receives an incorrect signal	Check speed signal from CTE
Leaking or blocked air pipes	Replace the air pipes
No air from neutral position valve in neutral position	Check neutral position valve and replace if necessary
Defective low-range switch (E561)	Replace low-range switch
Faulty VIC electronic unit	Replace electronic unit

SYMPTOM: GATES 1/2 AND 5/6 PERMANENTLY BLOCKED	
Possible cause	**Remedy**
Defective gearbox gate protection valve (B293)	Replace the gearbox gate protection valve
Gate protection active in high and low range	Check low-range switch

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4. MECHANICAL GEARBOX

4.1 FAULT-FINDING TABLE

SYMPTOM: ENGAGING GEARS IS HEAVY	
Possible cause	**Remedy**
Gearbox oil level too low	Top up oil level
Oil with incorrect specification in the gearbox	Fill gearbox with oil of correct specification
Problem in mechanical gearbox control	See “Mechanical gearbox control” fault-finding table
Clutch plate is not released	See “Clutch” fault-finding table

SYMPTOM: GEARS CANNOT BE ENGAGED	
Possible cause	**Remedy**
Retaining element fitted too deep	Check/repair retaining elements
Problem in mechanical gearbox control	See “Mechanical gearbox control” fault-finding table
Range-change gear does not work properly	See “Pneumatic section of gearbox control” fault-finding table

SYMPTOM: GEARBOX JUMPS OUT OF GEAR	
Possible cause	**Remedy**
Adjustment of selector shaft housing on gearbox	Mount selector shaft housing on gearbox without any play
Defective retaining element or wrong type of retaining element fitted in selector shaft housing	Replace retaining element or fit other type of retaining element
Problem in mechanical gearbox control	See “Mechanical gearbox control” fault-finding table

SYMPTOM: GEAR LEVER STUCK IN GATE 3/4	
Possible cause	**Remedy**
Oil leak in gate protection piston	Replace O-ring

SYMPTOM: SINGLE H BECOMES DOUBLE H	
Possible cause	**Remedy**
Locking plate in control cover not positioned correctly	Check assembly of control cover

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5. AUTOMATIC GEARBOX

5.1 READING/DELETING FAULT CODES

Fault code reading mode
To enter the fault code reading mode, briefly press the two arrow keys**twice simultaneously**. **"D-1"** appears on the display, followed by **"-"**. This means that at that point there are no faults (active faults) in the system. It also means that no faults have been registered that were earlier temporarily present and have now been cleared (inactive faults) The fault code reading mode can be left by pressing "D", "N" or "R" or the arrow keys.

If the red lamp lights up while reading a fault code, this means that there is an active fault in the gearbox.

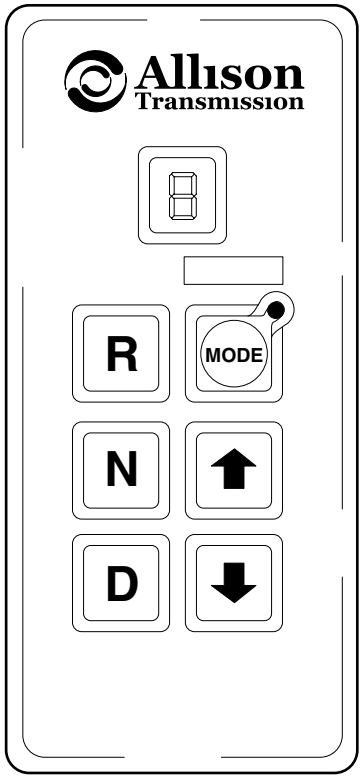
No message during reading means that the fault is inactive.
The ECU can save five active/inactive fault codes in its memory and show them on the display. Fault codes consist of two sets of two figures (main codes and sub-codes). To read the codes consecutively, the **"MODE"** button must be pressed each time.

The letters and figures appear one at a time after one other on the display.

Example:	D1	25 - 22
	D2	21 - 12
	D3	24 - 12
	D4	-

The hyphen after D4 means that there are no further faults and that it is therefore not necessary to look at level D5.

As the ECU can only contain the five most important codes, the five most important codes will be shown on D1 to D5. Only when one of the faults has been remedied will the ECU be in a position to show a less important fault.



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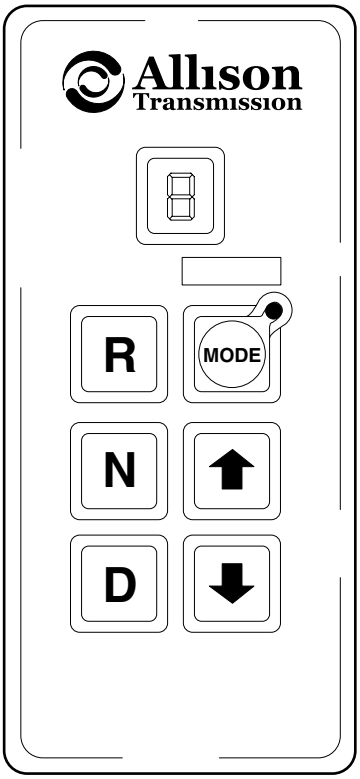
Deleting fault codes
After faults have been remedied, the ECU memory must be deleted. This is done as follows.
Press the arrow keys twice simultaneously. This is the fault code reading mode. Press the “MODE” key and hold it down until the red lamp flashes three times (the first flash will be after approx. three seconds, the second after approx. 10 seconds). All codes, active or inactive, have now been deleted. Codes which return following deleting and can therefore no longer be deleted are active. Both types of fault need their causes tracing and remedying as quickly as possible. After the fault codes have been deleted the ignition must be switched off and re-started; otherwise it will not be possible to drive. This can be seen from the flashing of the gear lever position.

Inactive faults are automatically deleted by the ECU if the fault no longer occurs after the contact has been switched off and on 25 times.

It is not possible to remedy all fault codes. Fault codes that cannot be found in the “Table of Fault Codes” can best be remedied by an Allison dealer.
He has test and diagnostic apparatus at his disposal that can be connected to a special diagnostic plug in the central box (next to the DAVIE connector).



V300392

5.2 TABLE OF FAULT CODES

Main code	Sub-code	RECOMMENDED PROCEDURES
Electronic control unit (ECU) supply		
13	12 Low 23 High	Check the following points: a. Earth and positive battery cables connected, firmly attached and clean. b. Batteries are charged. c. Vehicle loading system fails to load or loads too little or too much. d. VIM fuse (Vehicle Interface Module). e. VIM connections are firmly attached, clean and undamaged. f. The correct wiring is used. g. ECU connections are firmly attached, clean and undamaged. If all points are in order, contact your Allison dealer.
Accelerator pedal sensor		
21	12 23	Check the following points: a. Accelerator pedal sensor connector is connected. b. No interruptions or short circuits between wires or earth in wiring harness to accelerator pedal sensor. Replace the accelerator pedal sensor if necessary. If all points are in order, contact your Allison dealer.
Speed sensors		
22	14 15 16	Check the following points: a. Connectors are firmly attached, clean and undamaged. b. The speed sensor attachment bolt is tightened to the specified torque. c. No interruptions or short circuits between wires or earth in wiring harness to sensor. If all points are in order, contact your Allison dealer.
Selector keypad		
23	12 13 14 15 23 24	Check the following points: a. ECU connections - connectors are connected and clamped. b. Selector keypad is connected and the wire loop has been cut through. c. No interruptions or short circuits between wires or earth in wiring harness to selector. Replace the selector if necessary. If all points are in order, contact your Allison dealer.

Main code	Sub-code	RECOMMENDED PROCEDURES
		Temperature in the gearbox sump too low
24	12	Check the following points: a. Temperature is lower than -6°C. 1) If this is the case, it is a normal response to the ambient temperature. 2) If not, check whether the main gearbox is firmly connected and that the connectors are undamaged. If all points are in order, contact your Allison dealer.
		Temperature in the gearbox sump too high
24	23	1. Run the engine at idling speed. 2. Ensure that the vehicle is entirely horizontal. 3. Check whether the correct dip stick has been installed. 4. Check the oil level. 5. If necessary, correct the oil level. 6. If the oil level is in order, check whether the engine system has overheated, causing the gearbox to overheat. 7. Check that the ECU and gearbox connectors are correctly connected, firmly attached and undamaged. If all points are in order, contact your Allison dealer.
		Output shaft speed sensor
25	00 11 22 33 44 55 66 77	Check the following points: a. Connector is connected. b. Sensor bolt is firmly attached. c. ECU is firmly attached with no damaged connectors. d. Oil level. e. No interruptions or short circuits between wires or earth in wiring harness to sensor. If all points are in order, contact your Allison dealer.

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Main code	Sub-code	RECOMMENDED PROCEDURES
		Coupling 3 pressure switch open
32	00 33 55 77	1. Let the engine idle while the vehicle's parking brake is applied. Check the following points: a. Specified dip stick. b. Correct oil level. 2. Check the following points: a. Gearbox main connector is connected, is firmly attached, is clean and undamaged. b. ECU connector is connected, is firmly attached, is clean and undamaged. c. No interruptions or short circuits between wires or earth in wiring harness. If all points are in order, contact your Allison dealer.
		Sensor fault in gearbox oil sump
33	12 23	Check the following points: a. Gearbox main connector is connected, is firmly attached, is clean and undamaged. b. ECU connector is connected, is firmly attached, is clean and undamaged. c. No interruptions or short circuits between wires or earth in wiring harness. If all points are in order, contact your Allison dealer.
		EEPROM fault
34	12 13 14 15 16	1. Re-calibrate if possible. 2. If re-calibration is impossible, replace the ECU. 3. If ECU replacement is impossible, contact your Allison dealer.
		EEPROM writing error as a result of loss of power supply
35	00 16	Check the following points: a. ECU is firmly attached, clean and undamaged. b. VIM (Vehicle Interface Module) is firmly attached, clean and undamaged. c. The vehicle manufacturer has used the specified wiring for power supply and earth connection. d. Battery positive pole. e. Battery earth connection. f. Specified connections for vehicle ignition. If all points are in order, contact your Allison dealer.

Main code	Sub-code	RECOMMENDED PROCEDURES
		Hardware/software not compatible
36	00	1. Replace ECU if possible. 2. Re-program ECU if possible. 3. If replacement or re-programming is not possible, contact your Allison dealer.
		Interruption or short circuit in electromagnetic valve circuit
41	12 13 14 15 16 20 22 23 24 25 26	Check the following points: a. Gearbox main connector is connected, is firmly attached, is clean and undamaged. b. ECU connector is connected, is firmly attached, is clean and undamaged. c. Visual inspection of the wiring harness: no damage, no chafed or too taut wires, no screws through the wiring harness. d. No interruptions or short circuits between wires or earth in wiring harness. Replace wiring harness if necessary. If all points are in order, contact your Allison dealer.
		Short circuit in the electromagnetic valve circuit to the battery
42	12 13 14 15 16 21 22 23 24 25 26	Check the following points: a. Gearbox main connector is connected, is firmly attached, is clean and undamaged. b. ECU connector is connected, is firmly attached, is clean and undamaged. c. Visual inspection of the wiring harness: no damage, no chafed or too taut wires, no screws through the wiring harness. d. No interruptions or short circuits between wires or earth in wiring harness. e. Replace wiring harness if necessary. f. Incompetent repairs. If all points are in order, contact your Allison dealer.
		ECU circuits
43	21 25 26	1. Replace the ECU. 2. Contact your Allison dealer.

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Main code	Sub-code	RECOMMENDED PROCEDURES
Transmission ratio test on the gear to be changed from (during shifting).		
51	01 10 12 21 23 45 65	Check the following points: a. Output shaft engine speed sensor and rev sensor are connected. The connectors are undamaged and clean. b. No interruptions or short circuits between wires or earth in sensor wiring. c. Let the engine idle in neutral while the vehicle is on the brake. Check the following points: 1. Specified dip stick. 2. Oil level. If all points are in order, contact your Allison dealer.
Coupling 3 pressure switch fails to register pressure drop during shifting		
52	01 08 32 34 54 56 71 78 79 99	Check the following points: a. Output shaft engine speed sensor and rev sensor are connected. The connectors are undamaged and clean. b. No interruptions or short circuits between wires or earth in sensor wiring. c. Let the engine idle in neutral while the vehicle is on the brake. Check the following points: 1. Specified dip stick. 2. Oil level. d. Check that there is no interruption or short circuit between wires or earth connection in the main wiring harness to the gearbox. If all points are in order, contact your Allison dealer.
Engine and turbine rev test when engaging neutral		
53	08 18 28 29 38 39 48 49 58 59 68 69 78 99	Check the following points: a. Output shaft engine speed sensor and rev sensor are connected. The connectors are undamaged and clean. b. No interruptions or short circuits between wires or earth in sensor wiring. c. Let the engine idle in neutral while the vehicle is on the brake. Check the following points: 1. Specified dip stick. 2. Oil level. If all points are in order, contact your Allison dealer.

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Main code	Sub-code	RECOMMENDED PROCEDURES
Transmission ratio test immediately after changing gear		
54	01,07 10,12 17,21 23,32 34,43 45,54 56,65 70,71 80,81 83,85 86,92 93,95 96,97	Check the following points: a. Output shaft engine speed sensor and rev sensor are connected. The connectors are undamaged and clean. b. No interruptions or short circuits between wires or earth in sensor wiring. c. Let the engine idle in neutral while the vehicle is on the brake. Check the following points: 1. Specified dip stick. 2. Oil level. If all points are in order, contact your Allison dealer.
Pressure in coupling 3 immediately after changing gear.		
55	17 87 97	Check the following points: a. Output shaft engine speed sensor and rev sensor are connected. The connectors are undamaged and clean. b. No interruptions or short circuits between wires or earth in sensor wiring. c. Let the engine idle in neutral while the vehicle is on the brake. Check the following points: 1. Specified dip stick. 2. Oil level. d. Check that there is no interruption or short circuit between the wiring or earth connection in the coupling 3 pressure switch wiring. e. Check the following points: 1. Main connector is properly connected, is clean and undamaged., 2. ECU connector is properly connected, is clean and undamaged. 3. Rev sensor is properly connected, is clean and undamaged. If all points are in order, contact your Allison dealer.
Range test		
56	00 11 22 33 44 55 66 77	Check the following points: a. Output shaft engine speed sensor and rev sensor are connected. The connectors are undamaged and clean. b. No interruptions or short circuits between wires or earth in sensor wiring. c. Let the engine idle in neutral while the vehicle is on the brake. Check the following points: 1. Specified dip stick. 2. Oil level. If all points are in order, contact your Allison dealer.

Main code	Sub-code	RECOMMENDED PROCEDURES
		Range test when using coupling C3
57	11 22 44 66 88 99	Check the following points: a. Output shaft engine speed sensor and rev sensor are connected. The connectors are undamaged and clean. b. No interruptions or short circuits between wires or earth in sensor wiring. c. Let the engine idle in neutral while the vehicle is on the brake. Check the following points: 1. Specified dip stick. 2. Oil level. d. Check that there is no interruption or short circuit between the wiring or earth connection in the coupling 3 pressure switch wiring. e. Check the following points: 1. Main connector is properly connected, is clean and undamaged. 2. ECU connector is properly connected, is clean and undamaged. 3. Rev sensor is properly connected, is clean and undamaged. If all points are in order, contact your Allison dealer.
		Fault in ECU
69	12,13 14,15 16,21 22,23 24,25 26,32 33,34 35,36	1. Delete the fault codes and try to re-start the vehicle. 2. If the fault re-occurs, replace the ECU. 3. If the fault has not been cleared, contact your Allison dealer.

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6. CLUTCH

6.1 FAULT-FINDING TABLE

SYMPTOM: CLUTCH PEDAL FAILS TO RETURN	
Possible cause	**Remedy**
Broken pedal return spring	Replace spring
Worn clutch pedal bearing	Check bearing and replace, if necessary
Dirt in hydraulic system	Clean system and fill with fresh fluid
Incorrect fluid in hydraulic system	Replace with fluid of correct specification
Air in hydraulic system	Bleed the system

SYMPTOM: CLUTCH PEDAL STICKS WHEN PRESSED	
Possible cause	**Remedy**
Leak in hydraulic system	Check system
Air in hydraulic system	Bleed hydraulic system
Release bearing incorrectly fitted	Fit the release bearing correctly
Fork hinge points or fork itself worn	Check hinge points and fork; replace if necessary
Defective clutch servo	Repair and/or replace clutch servo
Gearbox front cover worn or broken	Check, replace gearbox front cover

SYMPTOM: PEDAL FORCE TOO HIGH	
Possible cause	**Remedy**
No or insufficient pressure in circuit 4 of the brake system	Check circuit 4 of the brake system
Kinked air pipe	Check pipe and replace, if necessary
Kinked hydraulic pipe	Check pipe and replace, if necessary
Worn clutch pedal bearing	Check bearing and replace, if necessary
Defective clutch servo and/or main cylinder	Repair or replace clutch servo and/or main cylinder Note: In the case of a swollen seal, clean the system and re-fill with new fluid.

1

SYMPTOM: RESIDUAL PRESSURE IN CLUTCH SYSTEM	
Possible cause	**Remedy**
Bleed in reservoir cap closed off	Check bleed in cap
Compensation bore in main cylinder closed off by swollen seal or insufficient free thrust pin travel.	Check free thrust pin travel or repair/replace main cylinder Note: In the case of a swollen seal, clean the system and re-fill with new fluid.

SYMPTOM: FLUID LEAK VIA VENT OPENING	
Possible cause	**Remedy**
Leak through piston seal in clutch servo	Repair or replace clutch servo Note: A drop of oil in the vent opening is a normal situation and is not a reason to repair/replace the clutch servo

SYMPTOM: CLUTCH PLATE SLIPS	
Possible cause	**Remedy**
Worn lining	Replace lining
Oil on lining	Replace lining and check engine and gearbox sealing rings
Dirt on clutch plate and flywheel	Clean plate and surrounding area
Burnt clutch plate	Check entire clutch and replace, if necessary
Clamping force of clutch release assembly too low or absent	Check clutch release assembly and replace, if necessary
Clutch release assembly is not released	Check clutch release assembly

SYMPTOM: CLUTCH RELEASE ASSEMBLY FAILS TO RELEASE	
Possible cause	**Remedy**
Fluid level in hydraulic system too low	Top up fluid
Incorrect pedal setting	Check setting and adjust if necessary
Air in hydraulic system	Bleed hydraulic system
Leak in hydraulic system	Check hydraulic system
Fingers of clutch release assembly broken	Replace clutch release assembly
Wrong clutch release assembly has been fitted	Fit correct clutch release assembly
Clutch fork is broken	Replace fork
Clutch release assembly severely contaminated	Clean entire clutch assembly
Defective clutch servo	Check clutch servo and replace, if necessary
Thrust bearing incorrectly fitted	Fit thrust bearing correctly
Clutch housing disconnected from gearbox	Tighten the clutch housing bolts to the correct torque

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7. PROP SHAFTS

7.1 FAULT-FINDING TABLE

SYMPTOM: VIBRATION IN DRIVE LINE AT LOW SPEED	
Possible cause	**Remedy**
Universal joint angle too large caused by e.g. excessive caster	Check universal joint angle
Play in universal joints	Replace universal joint
Play in centre bearing	Replace centre bearing
Play in sliding joint	Replace prop shaft
Forks not in line	Align forks

SYMPTOM: VIBRATION IN DRIVE LINE AT HIGH SPEED	
Possible cause	**Remedy**
Prop shaft imbalance	Balance prop shafts or replace if necessary

1

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8. ZF INTARDER

8.1 FAULT-FINDING TABLE

SYMPTOM: NO BRAKING MOMENT	
Possible cause	**Remedy**
Oil level too low	Check oil level
Intarder is not filled with the specified oil	Change the oil
No pump pressure	Check system
No control pressure	Check system
No intarder pressure	Check system

SYMPTOM: INSUFFICIENT BRAKING MOMENT	
Possible cause	**Remedy**
Oil level too low	Check oil level
Intarder is not filled with the specified oil	Change the oil
Pump pressure too low	Check system
Control pressure too low	Check system
Intarder pressure too low	Check system
Freewheeling turning torque system remains fully or partly switched on	Check the free movement of the plungers in the freewheeling turning torque system

SYMPTOM: CONSTANT BRAKING MOMENT WHEN INTARDER IS SWITCHED OFF	
Possible cause	**Remedy**
Oil level too high	Check oil level
Control pressure is independent of the position of the control lever	Check system

1

SYMPTOM: DELAYED RESPONSE	
Possible cause	**Remedy**
Air supply absent/too low	Check air supply
Intarder air supply valve is not activated	Check system
Intarder air supply valve does not empty accumulator in spite of activation	Check system
Idle pressure too low	Check system

SYMPTOM: DELAYED SWITCH-OFF	
Possible cause	**Remedy**
Slow decrease of intarder pressure after switch-off	Check system

SYMPTOM: OIL LEAK	
Possible cause	**Remedy**
Oil level too high	Check oil level
Oil leak between gearbox housing and intarder	Replace gasket
Oil leak in pump	Replace O-ring
Oil leak in proportional valve	Replace O-ring
Oil leak in the accumulator	Replace O-ring
Oil leak in the prop shaft flange	Replace O-ring

SYMPTOM: AIR LEAKAGE	
Possible cause	**Remedy**
Air leak via intarder air supply valve	Replace O-ring

SYMPTOM: COOLANT TEMPERATURE TOO HIGH	
Possible cause	**Remedy**
Coolant level too low	Check coolant level
Temperature adjustment	Check system
Intarder pressure present after intarder has been switched off	Check system

9. AS TRONIC

9.1 FAULT-FINDING TABLE

Using DAVIE, the air pressure can be examined after the pressure regulator. The air pressure before the pressure regulator can be measured using a pressure gauge on the screw valve of the AS Tronic air reservoir.

SYMPTOM: AIR SUPPLY PRESSURE TOO LOW	
Possible cause	**Remedy**
Air supply pressure too low due to: - Air leakage in air pipe from air supply unit to modulator pressure regulator - Pressure regulator factory setting disrupted	Check the following air connections: - Non-return valve at output 26 of the air supply unit - Pressure relief valve on transverse support in front of left front wheel - Both connections and valve on air reservoir of AS Tronic - Air connection of T-piece on modulator pressure regulator - Sealing ring between pressure regulator and modulator upper cover - Pressure regulator set screw seal (underside of pressure regulator under plastic cover) - Air lead-through sealing ring between modulator upper and lower covers - Air connection on clutch unit - Bleed screw, clutch unit
Defective or incorrectly functioning pressure regulator on modulator	- Replace pressure regulator

1

SYMPTOM: AIR SUPPLY PRESSURE TOO HIGH	
Possible cause	**Remedy**
- Defective or incorrectly functioning pressure regulator on modulator - Pressure regulator factory setting disrupted	- Check pressure regulator set screw seal (underside of pressure regulator under plastic cover) - Replace pressure regulator

SYMPTOM: SYSTEM NOT AVAILABLE ONCE ENGINE STARTED	
Possible cause	**Remedy**
During the system self-test clutch conditions cannot be stored due to: - jammed clutch plate on gearbox input shaft - clutch valves in clutch unit mechanically locked in open or closed position	Check whether clutch is released during self-test. - Remove inspection cover from clutch and check whether clutch operating unit changes position during self-test - If necessary replace the clutch unit - If necessary remove the gearbox so as to check the clutch parts

SYMPTOM: GEAR IS NOT ENGAGED WHEN OPERATING UNIT HAS BEEN SWITCHED ON VIA SELECTOR SWITCH	
Possible cause	**Remedy**
Signal of selected driving position from selector switch not received by gear lever unit	Check whether the wire from the relevant selector switch driving position to the gear lever unit is interrupted.

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CONTENTS

		Page	Date
1.	**GENERAL**	1-1	0111
1.1	Description of mechanical gearbox control	1-1	0111
1.2	Overview drawing, gear lever unit	1-2	0111
1.3	Overview drawing, gear lever	1-3	0111
2.	**INSPECTION AND ADJUSTMENT**	2-1	0111
2.1	Inspection and adjustment of gearbox control LHD/RHD	2-1	0111
3.	**REMOVAL AND INSTALLATION**	3-1	0111
3.1	Removal and installation, entire gear lever unit	3-1	0111
3.2	Removal and installation, gear lever gaiter	3-3	0111
3.3	Removal and installation, gear lever unit inner dust cover	3-6	0111
3.4	Removal and installation of gear lever ball	3-9	0111
3.5	Removal and installation, control rod	3-11	0111
3.6	Removal and installation, control rod ball joint	3-13	0111

2

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1. GENERAL

1.1 DESCRIPTION OF MECHANICAL GEARBOX CONTROL

Operating mechanism, LHD
When the gear lever is moved forwards, the control rod moves backwards.

When the gear lever is moved backwards, the control rod moves forwards.

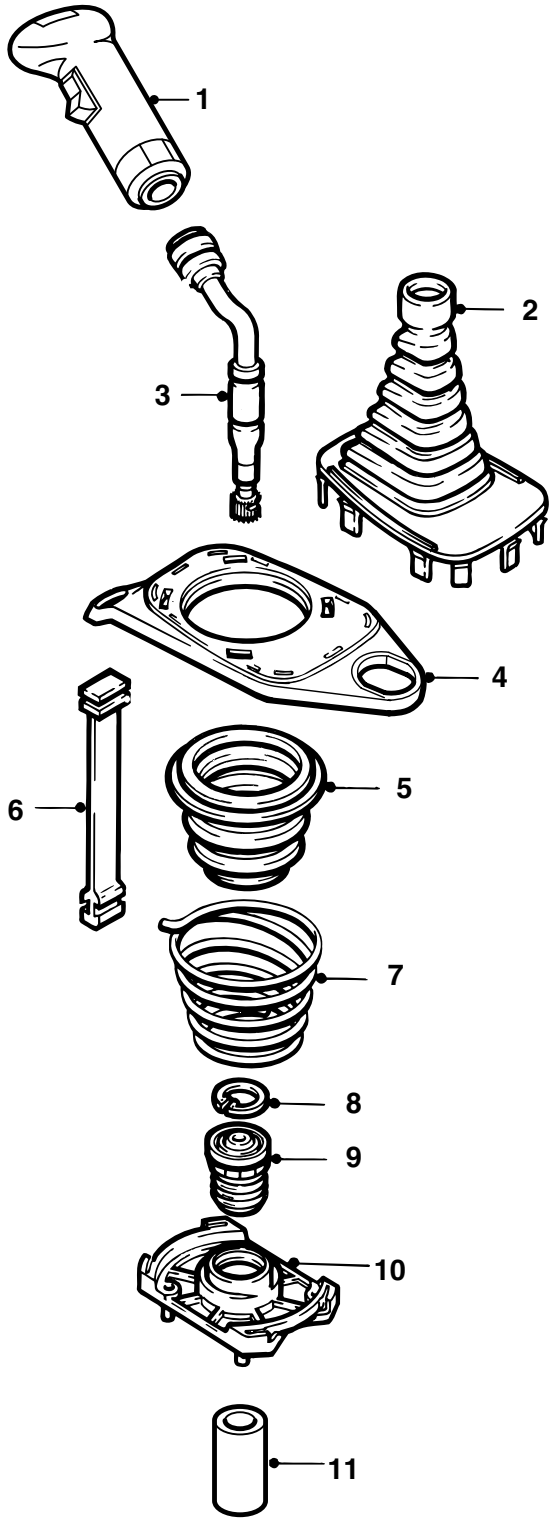
When the gear lever is moved left, the control rod moves right.

When the gear lever is moved right, the control rod moves left.

Operating mechanism, RHD
In the RHD version, the operating mechanism remains mounted in place. An additional control rod, passing over the engine to the right-hand side of the vehicle, is added to the control mechanism.

1.2 OVERVIEW DRAWING, GEAR LEVER UNIT

1. Switch
2. Gaiter
3. Gear lever
4. Retaining plate
5. Inner gaiter
6. Attachment tape
7. Pressure spring
8. Circlip
9. Gear lever ball
10. Bearing housing
11. Spacer sleeve



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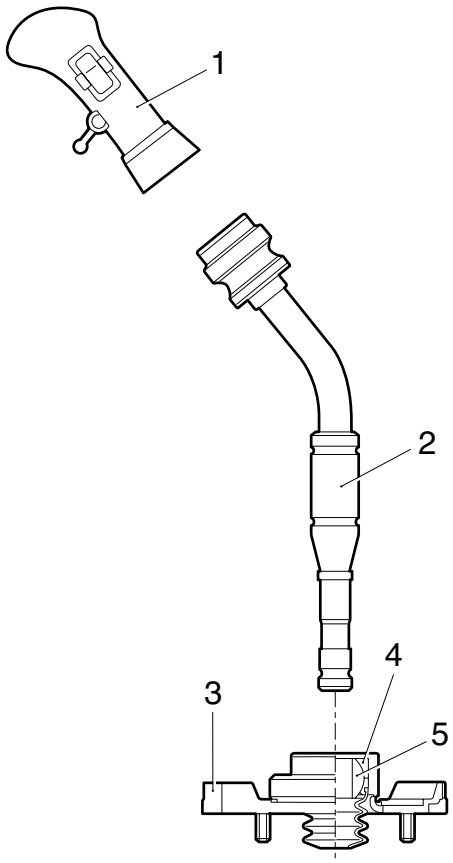
1.3 OVERVIEW DRAWING, GEAR LEVER

1. Switch
2. Gear lever
3. Bearing housing
4. Gear lever ball
5. Circlip



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2. INSPECTION AND ADJUSTMENT

2.1 INSPECTION AND ADJUSTMENT OF GEARBOX CONTROL LHD/RHD

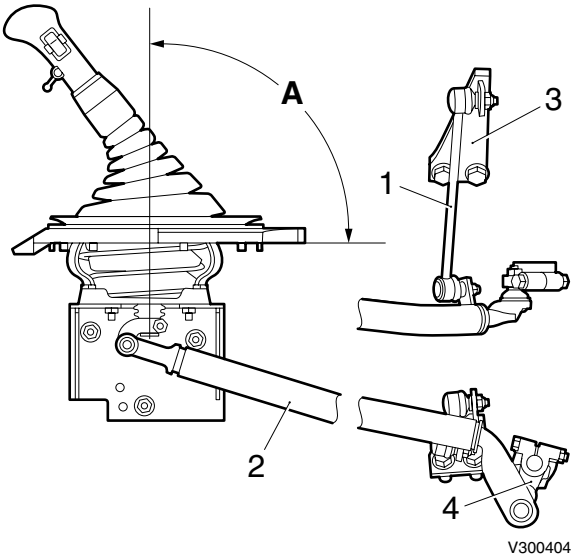
Inspection, gearbox control LHD/RHD

1. Push the control against the spring pressure to check whether it can move freely in neutral. The control should spring back independently into the 3/4 gate.
2. Check that all gears can be engaged without parts coming into contact with each other.

Adjustment, gearbox control LHD/RHD

1. Tilt the cab.
2. Remove the lever from the selector shaft.
3. Position the gear lever exactly in position A. See “Technical data”.
4. Check that the gearbox is in neutral.
5. Fit the selector shaft lever (4) to the selector shaft and fit the attachment bolt, tightening it to the specified torque. See “Technical data”.

   Note:
   The torque rod (1) of the gearbox control is equipped with fixed (non-adjustable) ball joints. If the torque rod (3) strut has been fitted correctly and the gear lever is exactly in position A, the shape of the control rod (2) will dictate the correct position of the lever (4) on the selector shaft.
6. Check that all gears can be engaged without parts coming into contact with each other.



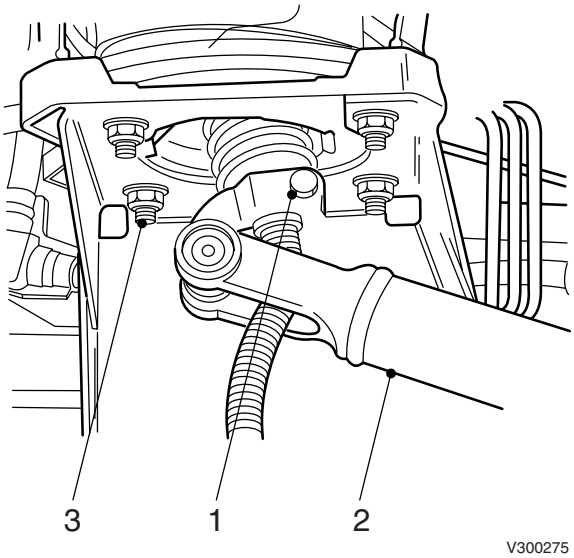
3. REMOVAL AND INSTALLATION

3.1 REMOVAL AND INSTALLATION, ENTIRE GEAR LEVER UNIT

Note:
If the vehicle is equipped with a gearbox without range-change switching or splitter box e.g. the ZF 6S850, the gear lever unit can be removed without it being necessary to consider the air pipes.

Removal, entire gear lever unit

1. Make sure there are no loose items in the cab. Tilt the cab.
2. After marking them, remove the air pipes that run from the switch to the various valves.
3. Remove the clamping bolt (1) and remove the gear lever control rod (2) and secure it so that it cannot cause any damage to the air pipes.
4. Remove the attachment nuts (3) on the bottom of the gear lever unit or those on the manifold bracket and then remove the entire gear lever unit including the set of air pipes.



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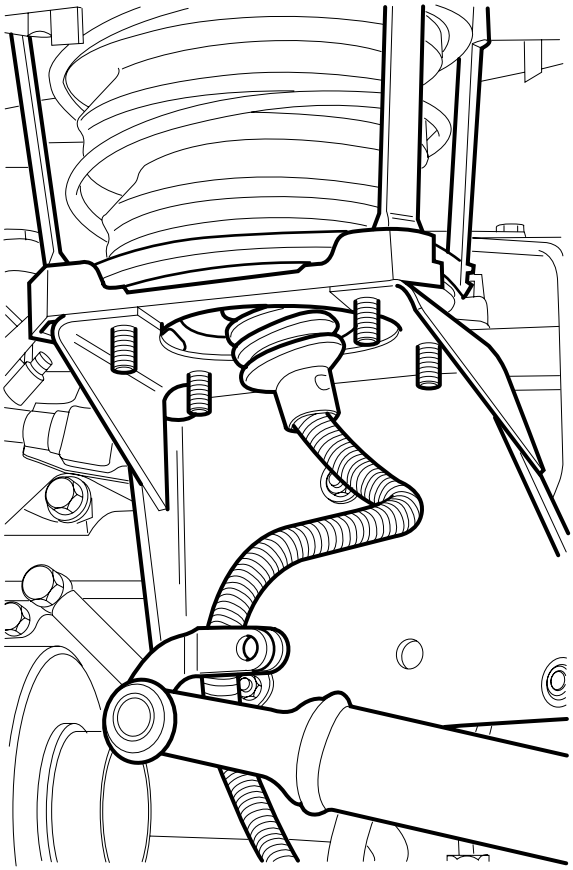
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Installation, entire gear lever unit

1. Fit the entire gear lever unit including the set of air pipes to the bottom of the shift unit or on the manifold bracket and fit the attachment nuts (3), tightening to the specified tightening torque. See “Technical data”.

   Note:
   When fitting the set of air pipes, make sure that these are away from any moving parts.

2. Fit the air pipes that run from the switch to the various valves.

3. Fit the gear lever control rod (2) to the gear lever unit and fit the clamping bolt (1), tightening to the specified tightening torque. See “Technical data”.

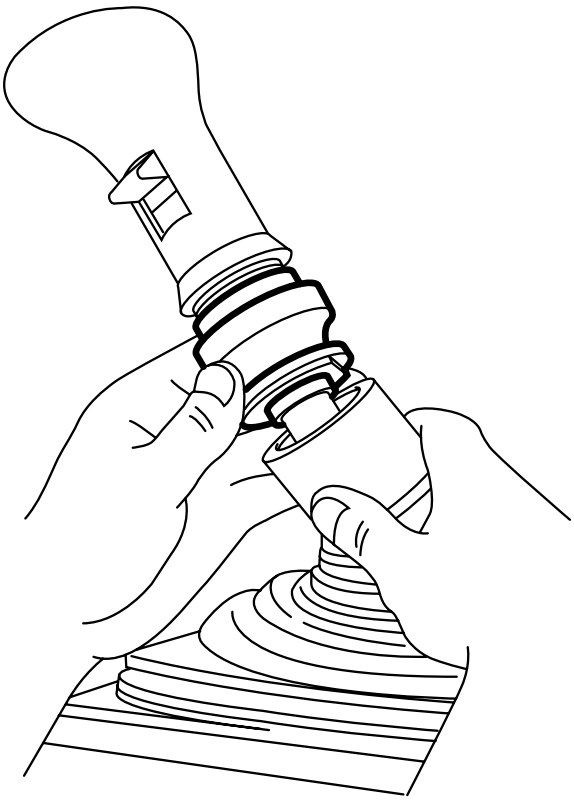
4. Check that the pneumatic system is airtight.

5. Check that all switches, both mechanical and pneumatic, function properly.

3.2 REMOVAL AND INSTALLATION, GEAR LEVER GAITER

Removing the gear lever gaiter

1. Make sure there are no loose items in the cab. Tilt the cab.
2. After marking them, remove the air pipes that run from the switch to the various valves.
3. Slide the gaiter over the threaded bush and then loosen it from the connection piece between the gear lever and the selector valve.
4. Remove the gear lever control rod and secure it so that no damage can be caused to the air pipes.



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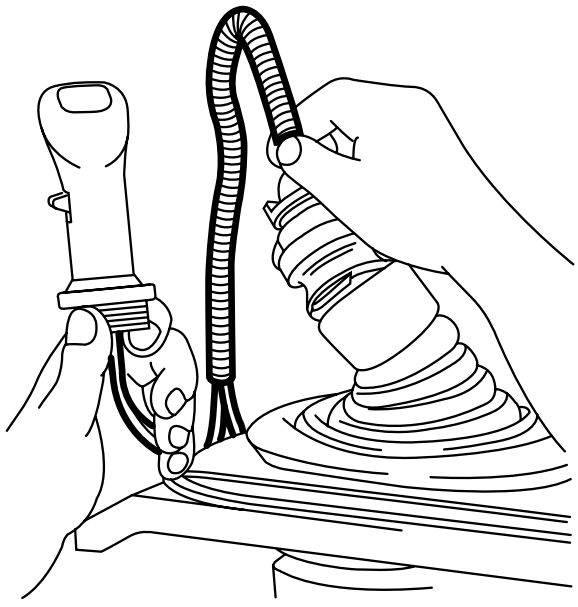
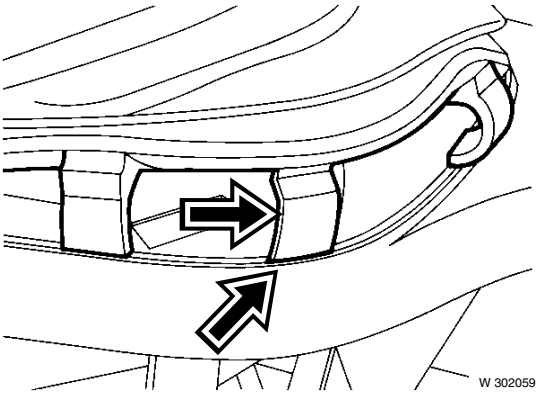
5. Remove the switch with the selector valve and air pipes from the gear lever.



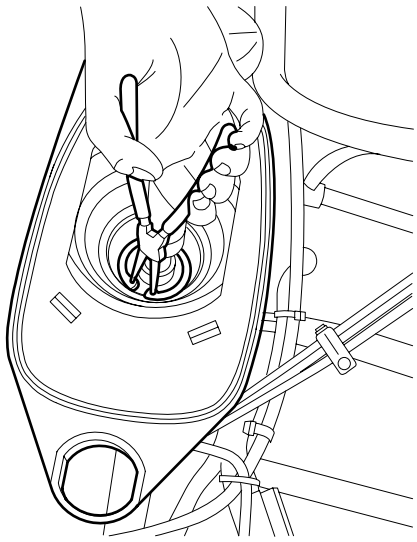
V300277

6. Loosen the gaiter from the locking plate by lifting the gaiter and pulling the gaiter lips away from the locking plate.



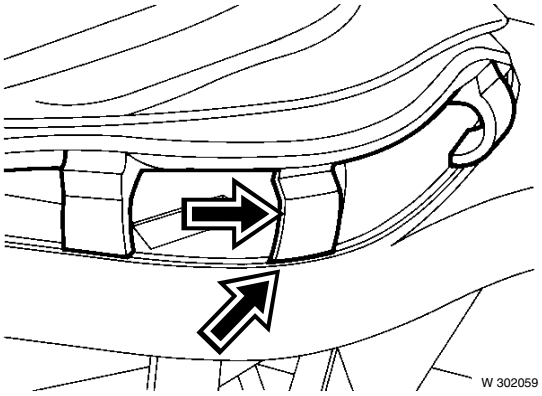
2

7. Then remove the Seeger ring that has become visible from the bearing cover. It is now possible to remove the entire gear lever from the bearing cover.
8. Use a press to remove the ball from the gear lever. Heat the ball if necessary.
9. Remove the gaiter.

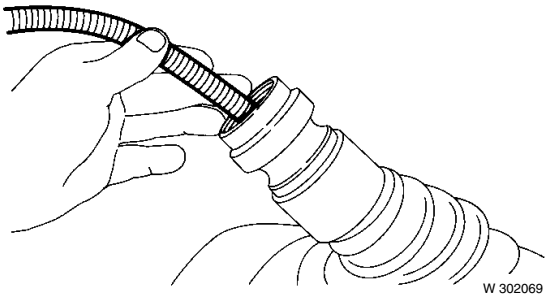


Installing the gear lever gaiter

1. Slide the gaiter over the gear lever.
2. Fit the ball.
3. Fit the entire gear lever to the shift unit and lock it with the specific Seeger ring.
4. Secure the gaiter by means of the lips. These must be pulled through the slots in the locking plate.



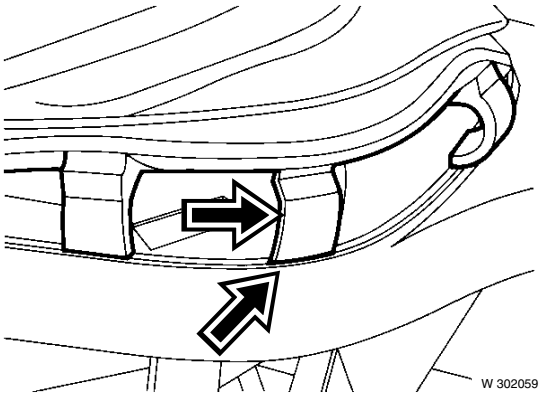
5. Feed the air pipes through the gear lever and fit the switch with the valve to the gear lever. Tighten the threaded bush and slide the gaiter over the threaded bush.
6. Fit the selector rod.
7. Connect the air pipes. Ensure that the pipes are clear of any moving parts.
8. Check that the pneumatic system is airtight.
9. Check that all switches, both mechanical and pneumatic, function properly.



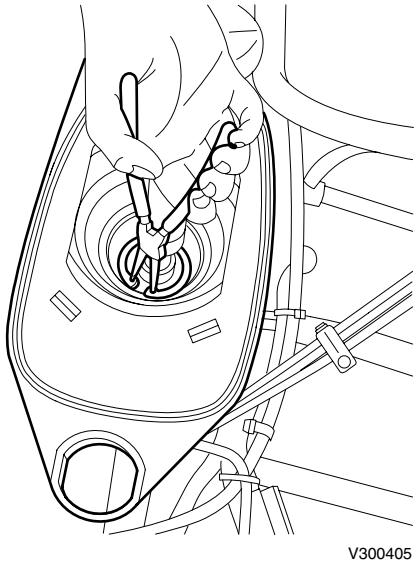
3.3 REMOVAL AND INSTALLATION, GEAR LEVER UNIT INNER DUST COVER

Removal, gear lever unit inner dust cover

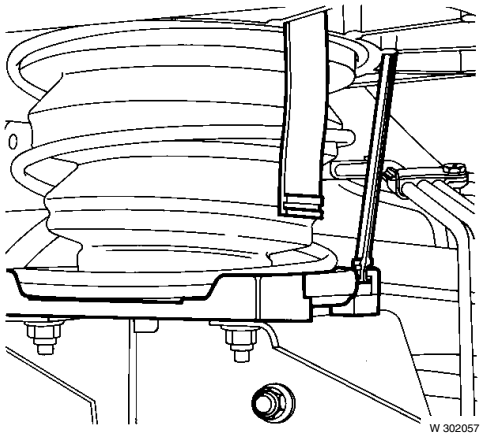
1. Remove the entire gear lever unit from the bracket.
2. Loosen the gaiter from the locking plate by lifting the gaiter and pulling the gaiter lips away from the locking plate.



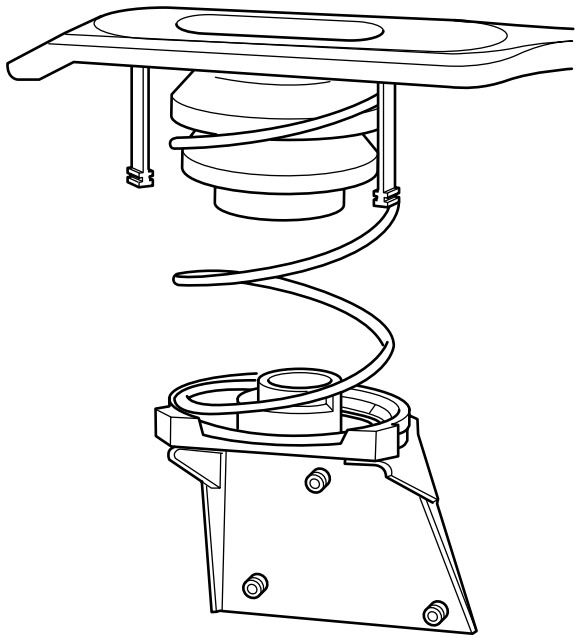
3. Then remove the Seeger ring that has become visible from the bearing cover. It is now possible to remove the entire gear lever from the bearing cover.



4. Press the locking plate down and slide the four attachment bands from the bearing cover slots.



5. Remove the locking plate with the dust cover and spring from the bearing cover.
6. Remove the dust cover from the locking plate.

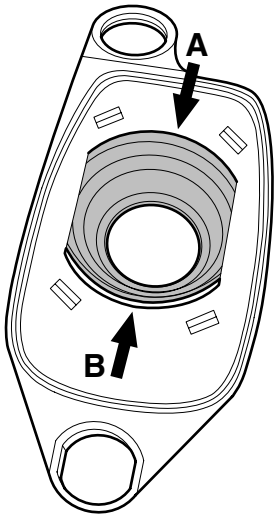


V300278

Installation, gear lever unit inner dust cover

1. Fit the inner dust cover.

   Note:
   When fitting the inner dust cover, ensure that it is fitted properly to the locking plate as can be seen in position A. Fitting as in position B will lead to irritating engine noise in the cab.



V300406

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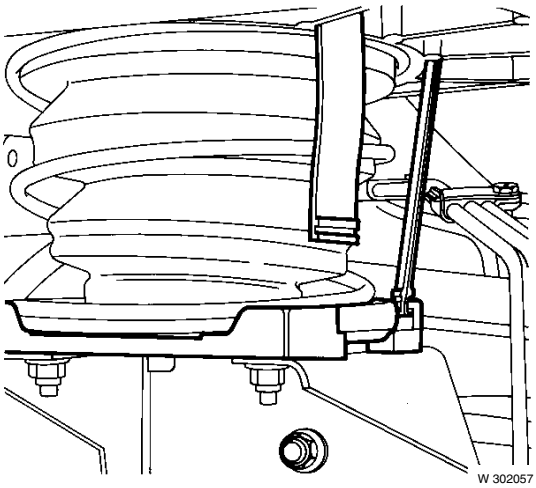
2. Press the locking plate and spring down and fit the four attachment bands in the bearing cover slots.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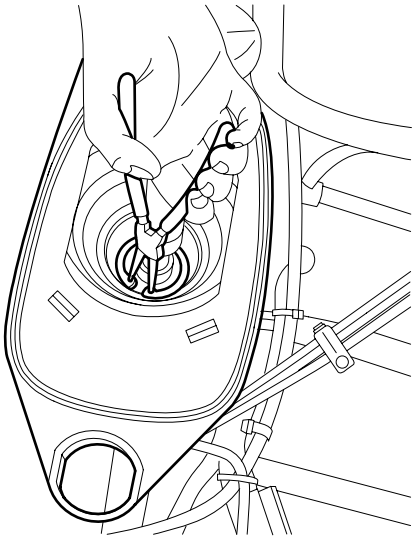
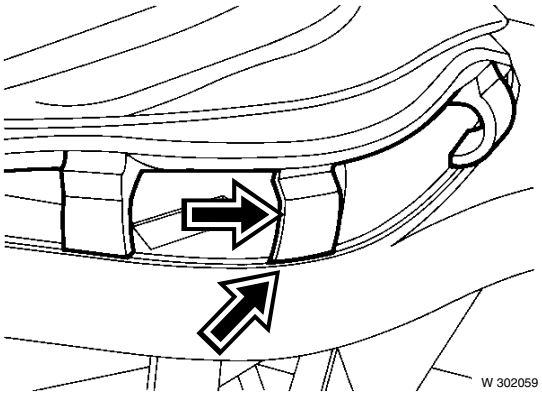
3. Fit the gear lever with the bearing to the bearing cover and fit the snap ring.


V300405

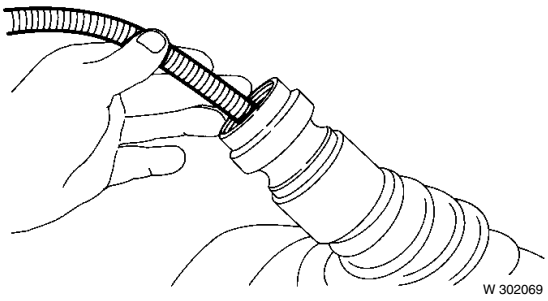
4. Secure the gaiter by means of the lips. These must be pulled through the slots in the locking plate.
5. Fit the selector rod.
6. Connect the air pipes. Ensure that the pipes are clear of any moving parts.
7. Check that the pneumatic system is airtight.
8. Check that all switches, both mechanical and pneumatic, function properly.


W 302059

3.4 REMOVAL AND INSTALLATION OF GEAR LEVER BALL

Removing the gear lever ball

1. Make sure there are no loose items in the cab. Tilt the cab.
2. After marking them, remove the air pipes that run from the switch to the various valves.
3. Slide the gaiter over the threaded bush and then loosen it from the connection piece between the gear lever and the selector valve.
4. Remove the gear lever control rod and secure it so that no damage can be caused to the air pipes.
5. Remove the switch with the selector valve and air pipes from the gear lever.
6. Loosen the gaiter from the locking plate by lifting the gaiter and pulling the gaiter lips away from the locking plate.
7. Then remove the Seeger ring that has become visible from the bearing cover. It is now possible to remove the gear lever from the bearing cover.
8. Use a press to remove the ball from the gear lever.
   Heat the ball if necessary.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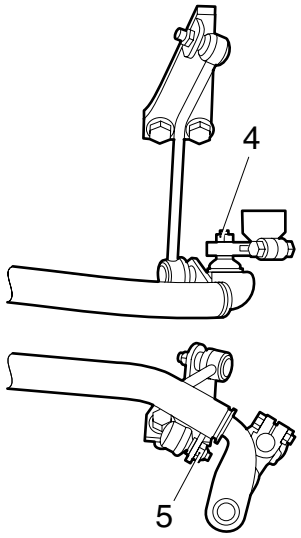
Installing the gear lever ball

1. Apply a degreasing agent to the surfaces of the gear lever and ball that are to be glued. See “Technical data”. Immediately wipe the surfaces with a clean piece of paper or a lint-free cloth.
2. Apply glue to the gluing surface of the gear lever and all around the ball. See “Technical data”.
3. Position the gear lever in the ball and check that the pipe is not pushed out. Turn the gear lever once or twice to achieve a good bond.
4. Place the gear lever and ball to one side **in a vertical position** and leave the assembly to harden for 10 minutes.
5. Remove excess adhesive from the ball.
6. Fit the gear lever into the bearing cover and fit the snap ring.
7. Secure the gaiter by means of the lips. These must be pulled through the slots in the locking plate.
8. Connect the air pipes. Ensure that the pipes are clear of any moving parts.
9. Check that the pneumatic system is airtight.
10. Check that all switches, both mechanical and pneumatic, function properly.

3.5 REMOVAL AND INSTALLATION, CONTROL ROD

Removing the control rod

1. Make sure there are no loose items in the cab. Tilt the cab.
2. After marking them, remove the air pipes that run from the switch to the various valves.
3. Remove the lock nut (4) from the torque rod ball joint and remove the torque rod from the control rod.
4. Remove the castle nut from the ball joint on the gearbox lever and remove the control rod.



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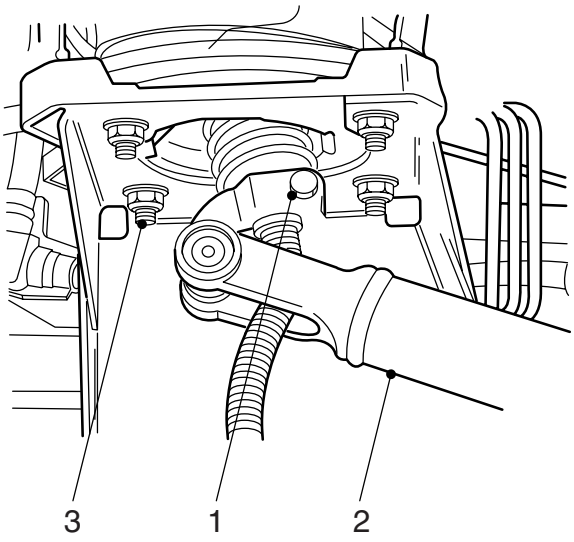
5. Remove the clamping bolt (1) and remove the control rod (2) from the gear lever unit.



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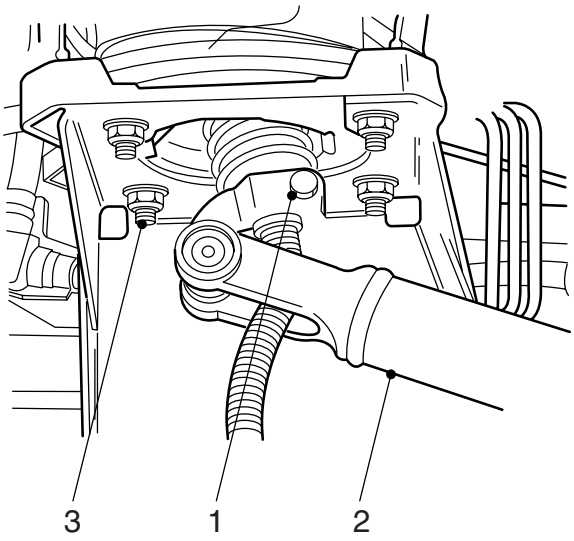
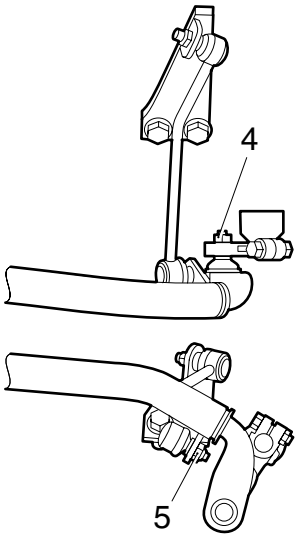
Installing the control rod

1. Position the control rod.
2. Fit the control rod (2) onto the gear lever unit and hand tighten the clamping bolt (1). For the required torque, see “Technical data”.



V300275

3. Fit the torque rod to the control rod and tighten the ball joint lock nut (4) to the specified tightening torque.
4. Check that the gearbox is in neutral.
5. Position the gear lever exactly in position A. See “Technical data”.
6. Fit the control rod with the ball joint on the lever of the selector shaft.
7. Tighten the castle nut (5) to the specified torque. See “Technical data”. Place a split pin on the castle nut.
8. Check that all switches, both mechanical and pneumatic, function properly.



V300407

3.6 REMOVAL AND INSTALLATION, CONTROL ROD BALL JOINT

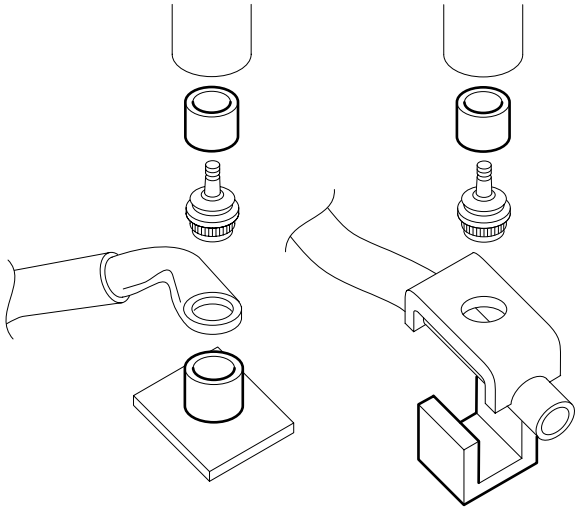
Note:
Ensure that the section of the control rod in which the ball joint is fitted is well supported when the ball is being forced on or off. This will prevent deformation of the control rod. The clamping of a newly mounted press-on ball will also be guaranteed.

If the control rod is deformed in any way, it should be replaced.
Ball joints which have been used previously must on no account be used again.

Removing the control rod ball joint
1. Remove the control rod. See “Removal and installation”.
2. Using evenly-distributed force, remove the ball joint from the control rod.

Installing the control rod ball joint
1. Clean the surfaces to be bonded and degrease them.
2. Apply glue to the bonding surface of the knurled edge of the ball joint. See “Technical data”.
3. Using evenly-distributed force, fit the ball joint onto the control rod.

   Note:
   Make sure that the part being pushed on to the control rod receives proper support.
4. Fit the control rod. See “Removal and installation”.
5. Check that all switches function properly, from a mechanical point of view.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CONTENTS

		Page	Date
1.	**GENERAL**	1-1	200337
1.1	System description, pneumatically assisted gearbox control (Servoshift)	1-1	200337
2.	**DESCRIPTION OF COMPONENTS**	2-1	200337
2.1	Servoshift unit operation	2-1	200337
2.2	Function of the emergency selector	2-7	200337
3.	**REMOVAL AND INSTALLATION**	3-1	200337
3.1	Removal and installation, Servoshift unit	3-1	200337

3

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1. GENERAL

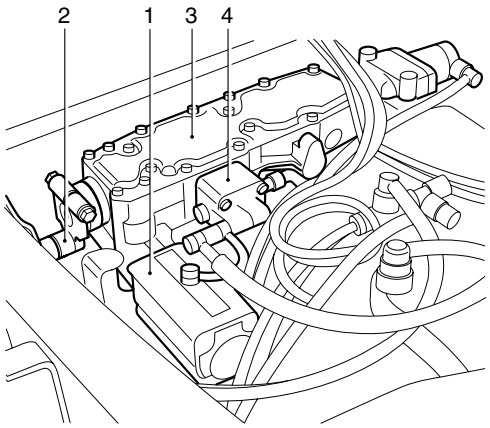
1.1 SYSTEM DESCRIPTION, PNEUMATICALLY ASSISTED GEARBOX CONTROL (SERVOSHIFT)

The “Servoshift” pneumatically assisted gearbox control is an assisted mechanical/pneumatic gear selector system for the gearbox.
This system is identical to the mechanical gearbox controls, from the gear lever to the gearbox, however, the gearbox is pneumatically assisted.
For details of adjustments to the selector mechanism, refer to “Mechanical gearbox control”.
The Servoshift unit is an important feature of the pneumatically assisted gearbox control.

The Servoshift unit can be ventilated in two ways:

1. Ventilation via the neutral position valve (4):

1. Servoshift unit
2. Selector rod
3. Selector shaft housing
4. Neutral position valve

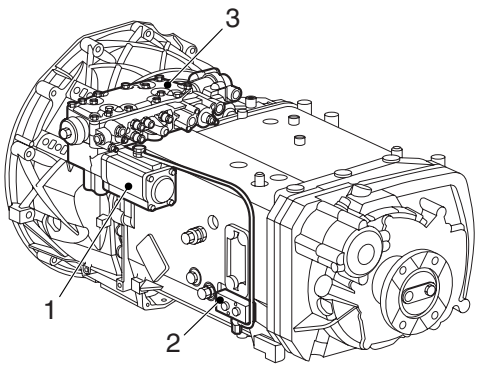


V300409

2. Ventilation via the splitter relay valve (2):

1. Servoshift unit
2. Splitter relay valve
3. Selector shaft housing (with integrated air distribution block)

As a result, pneumatic clutch support via the Servoshift unit (1) can only be provided when the clutch is fully depressed.



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Gate selection
Gates are selected mechanically.
To select a gate, move the gear lever to the left or to the right, which moves the selector shaft to the left or to the right.

Engaging gears
To engage the gears, move the gear lever forwards or backwards.

Switching begins mechanically with the operation of the selector valve in the Servoshift unit. This valve controls the double-acting pneumatic cylinder, and the selection is pneumatically assisted.

Emergency selector
If there is no air pressure, selection can still be done mechanically, i.e. non-assisted.

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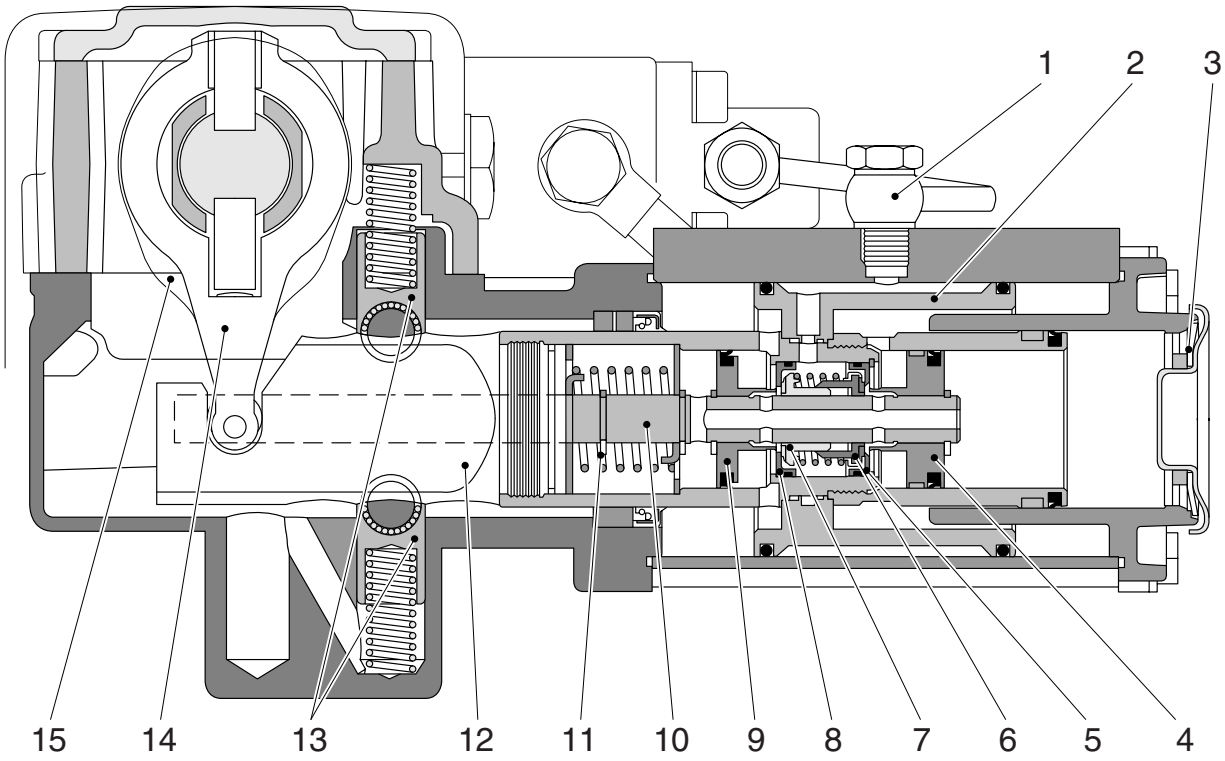
2. DESCRIPTION OF COMPONENTS

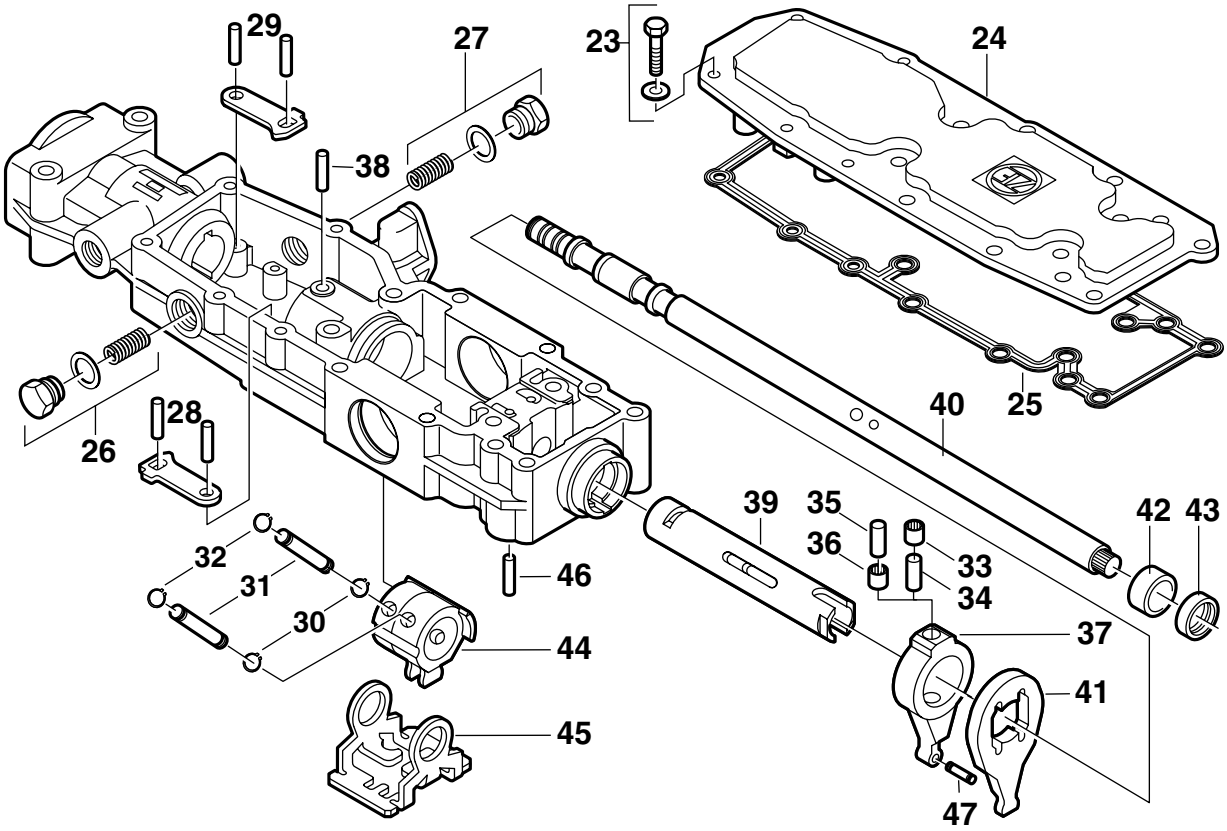
2.1 SERVOSHIFT UNIT OPERATION



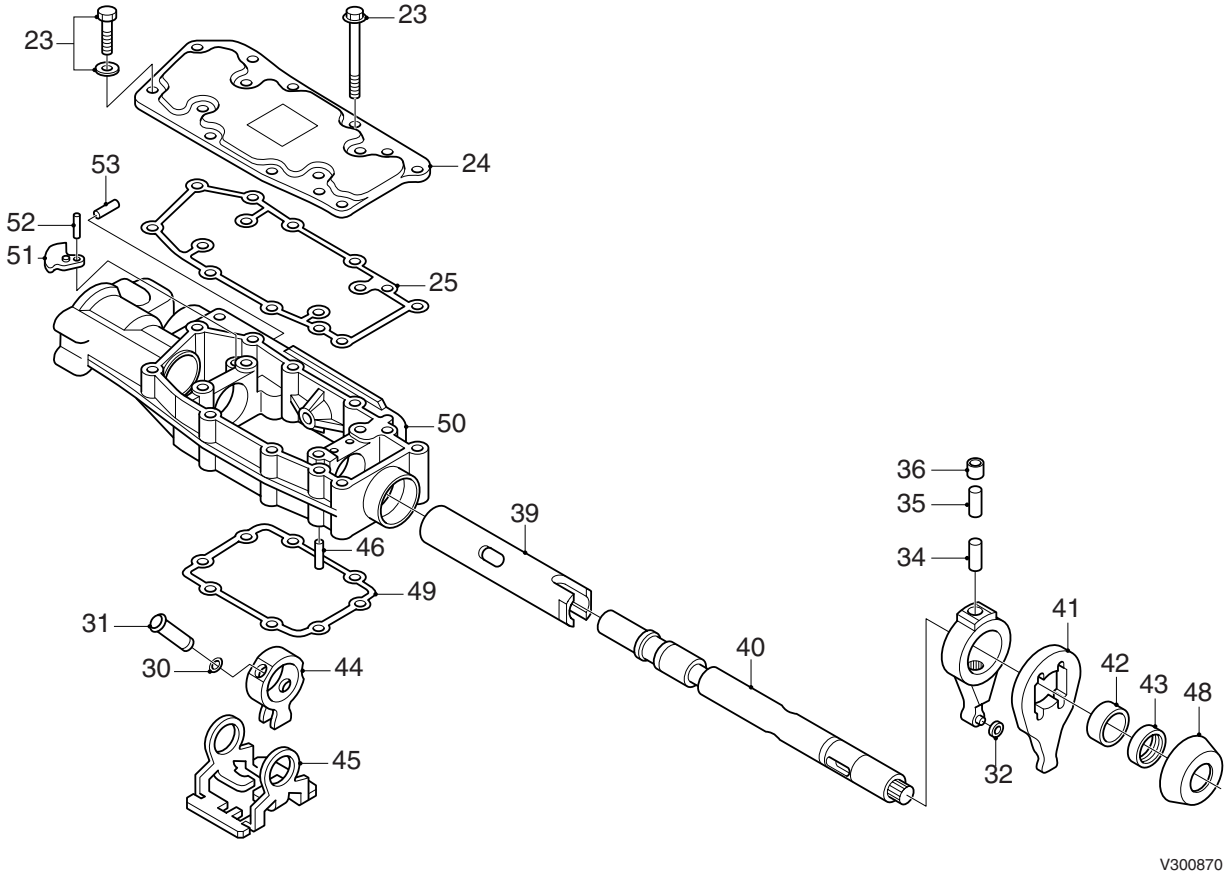
1. Supply pressure connection (circuit 4)
2. Operating piston
3. Venting valve
4. Selector valve for operating piston, 1st, 3rd, 5th, 7th gear
5. Valve seat, 1st, 3rd, 5th, 7th gear
6. Valve, 1st, 3rd, 5th, 7th gear
7. Valve, 2st, 4rd, 6th, 8th gear
8. Valve seat, 2nd, 4th, 6th, 8th gear
9. Selector valve for operating piston, 2nd, 4th, 6th, 8th gear
10. Piston selector valve
11. Selector valve spring
12. Servo-operating shaft
13. Retaining elements
14. Servo-lever
15. Selector valve lever

SERVOSHIFT SELECTOR SHAFT HOUSING

Situation with separate air distribution block:

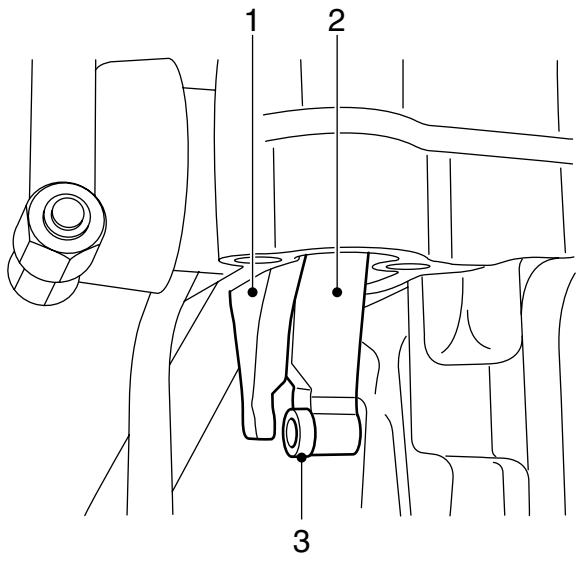


Situation with integrated air distribution block:



23. Attachment bolt
24. Selector housing cover
25. Selector housing cover gasket
26. Sealing plug
27. Sealing plug
28. Locking plate
29. Locking plate
30. Circlip
31. Attachment pin
32. Circlip
33. Needle bush
34. Pin
35. Pin
36. Needle bush
37. Selector valve lever
38. Pin
39. Hollow shaft (selector valve lever)
40. Selector shaft
41. Servo-lever
42. Bush
43. Selector shaft oil seal
44. Selector finger
45. Locking piece
46. Pin
47. Fixing pin
48. Dust cover
49. Gasket
50. Selector housing
51. Locking cylinder lever
52. Attachment pin
53. Neutral switch attachment pin

General
The Servoshift unit consists of a selector valve and a double-action cylinder.
When the control rod is moved forwards or backwards, the selector valve lever (2) is operated first. This operates the selector valve in the Servoshift unit, so that air acts on the piston and the piston will operate the servo lever (1). The gear is now selected.
When the gears are activated and the gear lever is no longer operated, the selector valve is pressed back into the neutral position by the spring and the piston is bled on both sides.



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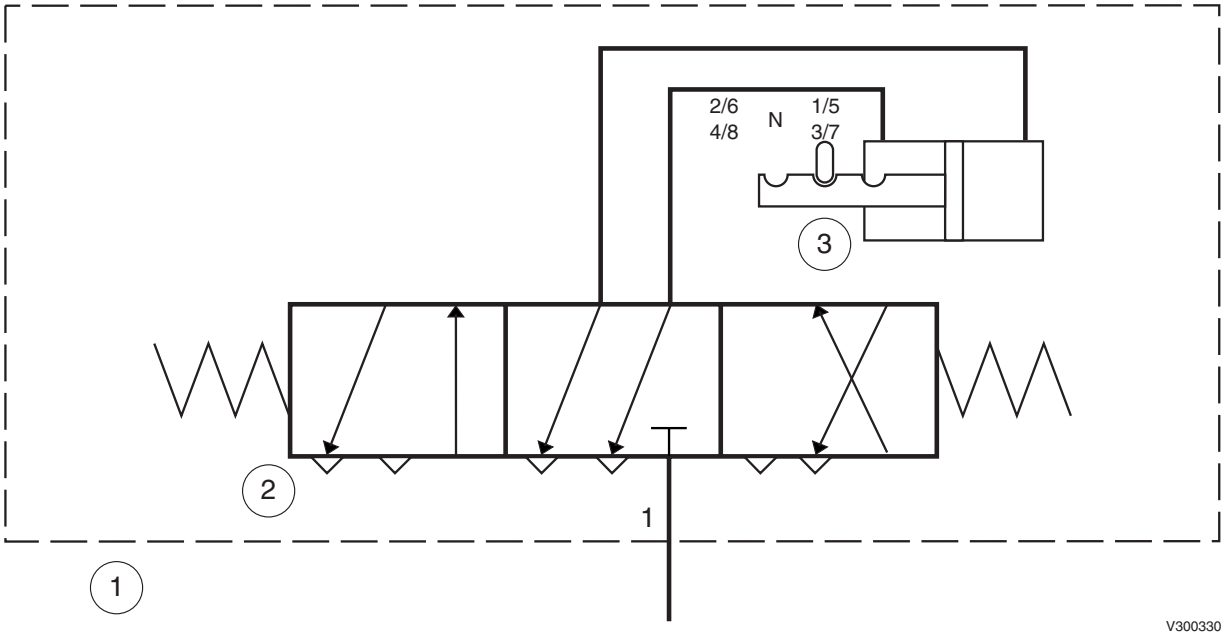
Neutral position

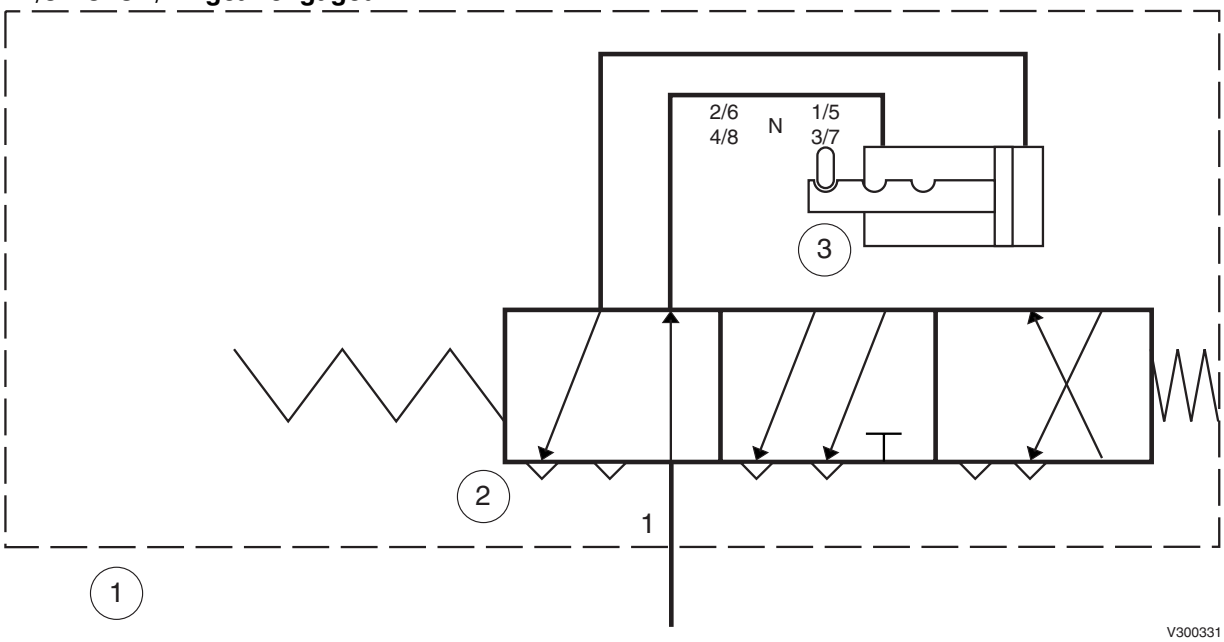


V300330

1. Servoshift unit
2. Selector valve
3. Operating cylinder

When the selector valve is in the centre position, bleeding will take place on both sides of the cylinder. Only when the gear lever is operated will the selector valve be operated. The selector valve will then apply pressure on one side of the cylinder, so that a gear is engaged.

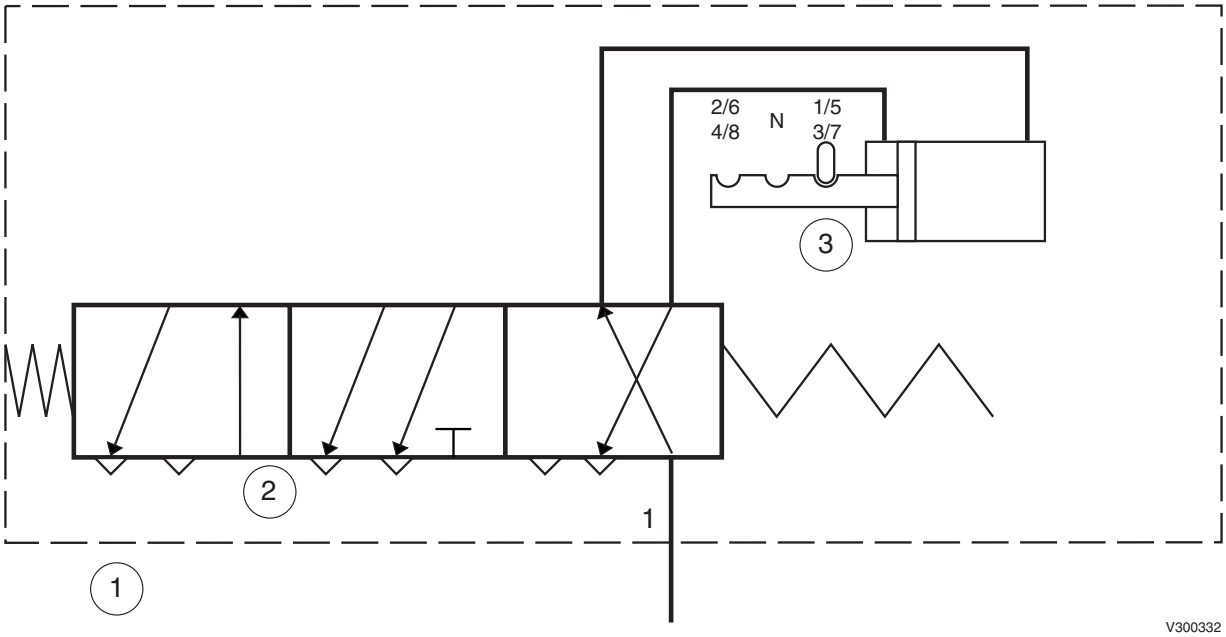
1st/5th or 3rd/7th gear engaged



1. Servoshift unit
2. Selector valve
3. Operating cylinder

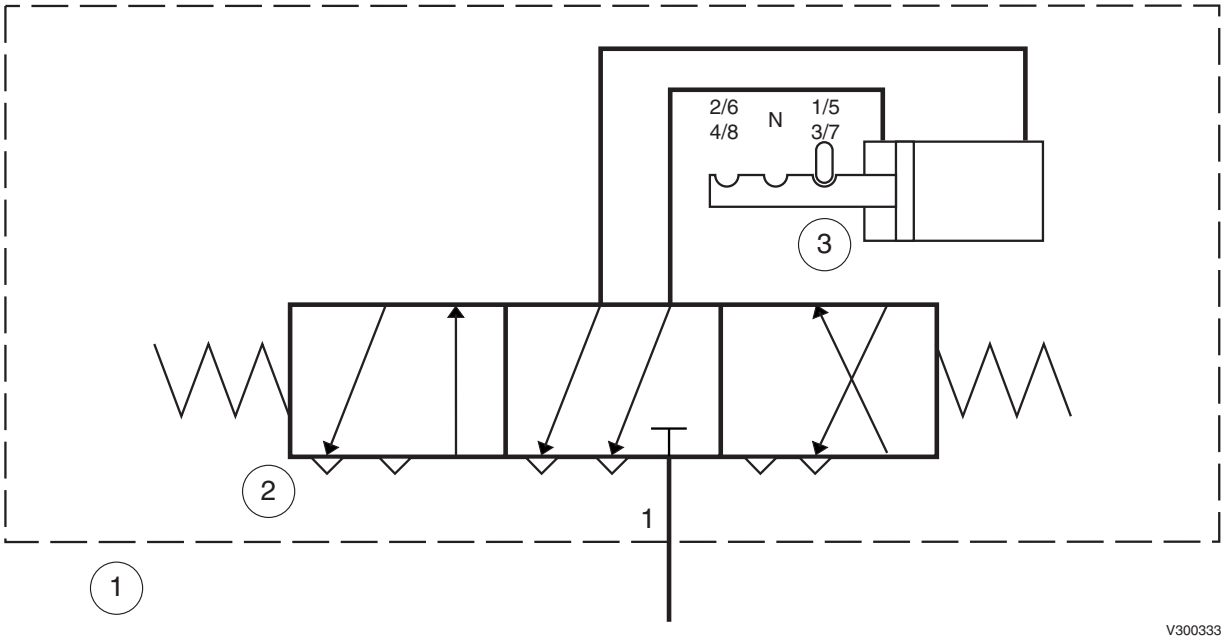
When the gear lever is moved forwards, the selector valve moves to the right. Supply pressure is thereby applied to the left side of the cylinder, and the cylinder moves to the right. The right side is bled when this happens. When the cylinder reaches the end position, it switches off the air supply. Supply pressure will only be applied to the cylinder if the gear lever is in operation. When the gear lever is released, the selector valve goes back to the centre position, and the cylinder is bled on both sides. The cylinder remains in position due to the double-retaining arrangement.
If it is desired to change to the 2nd/6th or 4th/8th position, the selector valve must be moved to the left until the cylinder moves to the 2nd/6th or 4th/8th position passing through the neutral position.

2st/6th or 4rd/8th gear engaged



V300332

When the cylinder is in the 2nd/6th or 4th/8th position and the gear lever is again released, the selector valve will again spring back to the middle position while the cylinder remains in the switched position due to the double-retaining arrangement.



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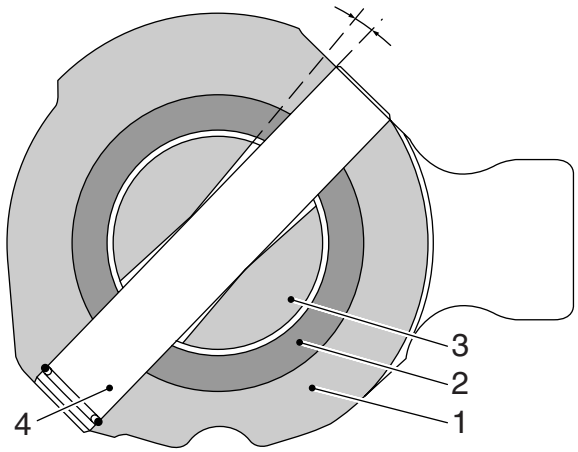
2.2 FUNCTION OF THE EMERGENCY SELECTOR

It is still possible to change all the gears even without pneumatic power if the air pressure should fail.
In such case, a small amount of play between the selector shaft (3) and the attachment pin (4) will have to be bypassed before the selector finger (1) is operated. The hollow shaft (2) will be operated by the Servoshift operating cylinder if the system is working properly.

1. Selector finger
2. Hollow shaft powering system
3. Selector shaft operated by the gear lever
4. Attachment pin



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3. REMOVAL AND INSTALLATION

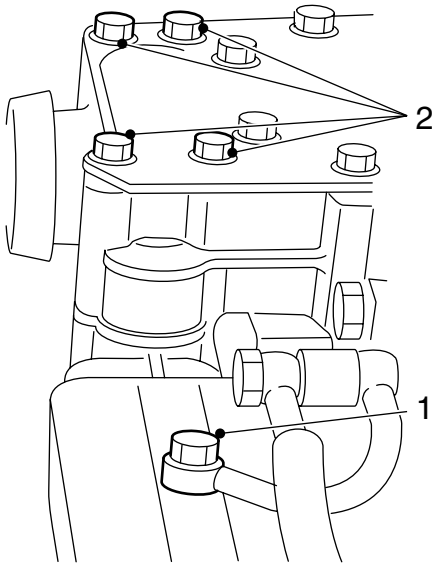
3.1 REMOVAL AND INSTALLATION, SERVOSHIFT UNIT

Removing Servoshift unit

1. Ensure that the air pipe (1) is pressureless before the banjo bolt is removed.
2. Remove the banjo bolt from the air pipe (1) and plug the connection on the unit so that no dirt can enter.

Note:
While removing the Servoshift unit from the selector shaft housing, a small amount of oil will escape.

3. Remove the four attachment bolts (2) of the Servoshift unit and remove the unit.



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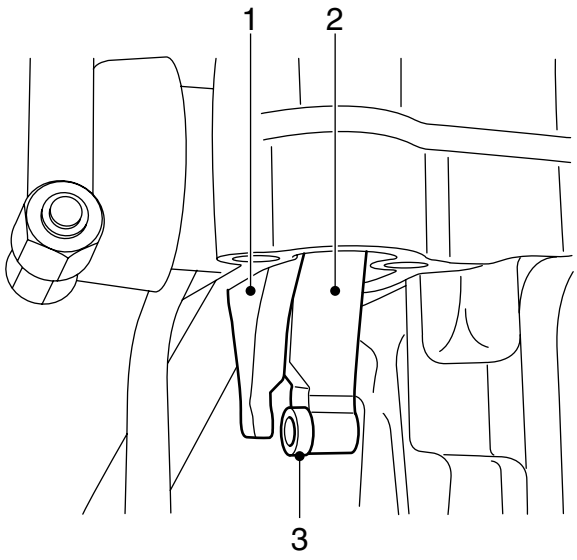
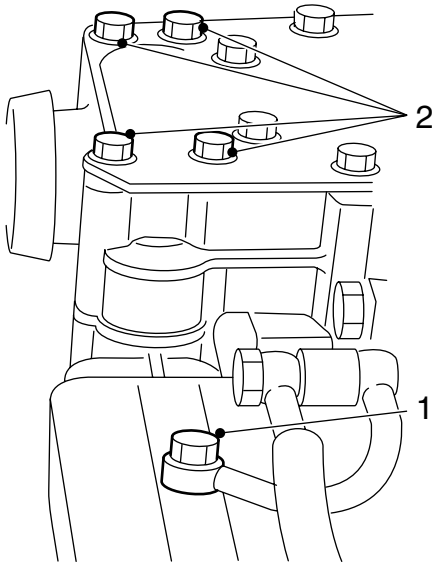
Note:
Be aware of the ring (3), which is placed loose on the selector valve lever.



V300327

Installing Servoshift unit

1. Fit the Servoshift unit using a new gasket.
2. Tighten the attachment bolts (2) to the specified torque. See “Technical data”.
3. Fit the banjo bolt for the air pipe (1) with new sealing rings and tighten to the specified torque. See “Technical data”.
4. Repressurise the air circuit and check the operation of the Servoshift unit.



V300328

CONTENTS

		Page	Date
1.	**GENERAL**	1-1	200337
1.1	Location of components of the downshift protection for ZF/Eaton gearboxes	1-1	200337
1.2	System description, downshift protection	1-7	200337
1.3	Location of gate protection components	1-12	200337
1.4	System description, gate protection	1-15	200337
1.5	Pneumatic diagram, gearbox control	1-17	200337
2.	**DESCRIPTION OF COMPONENTS**	2-1	200337
2.1	Integrated air distribution block	2-1	200337
2.2	Neutral position valve	2-4	200337
2.3	Downshift protection valve	2-7	200337
2.4	High/low range engaging cylinder	2-9	200337
2.5	Gear lever selector valve	2-10	200337
2.6	GV valve	2-12	200337
2.7	Splitter relay valve	2-13	200337
2.8	Filter/governor, Eaton FS/6309A	2-14	200337
3.	**INSPECTION AND ADJUSTMENT**	3-1	200337
3.1	Simulation of the speed signal	3-1	200337
3.2	Inspection, downshift protection valve	3-2	200337
3.3	Inspection and adjustment, ZF/Eaton gearbox GV valve	3-4	200337
3.4	Inspection, filter/governor, Eaton FS/6309A	3-7	200337
4.	**REMOVAL AND INSTALLATION**	4-1	200337
4.1	Removal and installation, gear lever selector valve	4-1	200337
5.	**CLEANING**	5-1	200337
5.1	Cleaning filter/governor, Eaton FS/6309A	5-1	200337

4

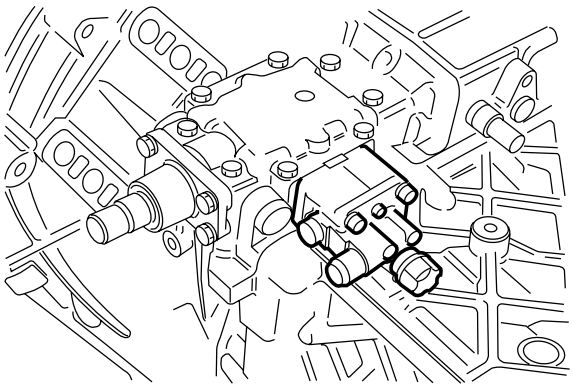
© 200337

1. GENERAL

1.1 LOCATION OF COMPONENTS OF THE DOWNSHIFT PROTECTION FOR ZF/EATON GEARBOXES

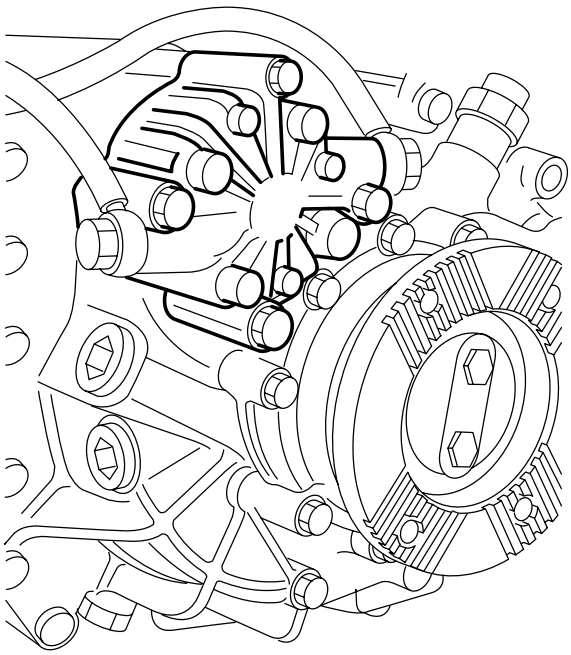
ZF gearboxes ZF 8/9/16S-109

1. **Neutral position valve**
   At the side of the selector shaft housing on the gearbox.



V300140

2. **Range-change gear engaging cylinder**
   At the back of the gearbox.

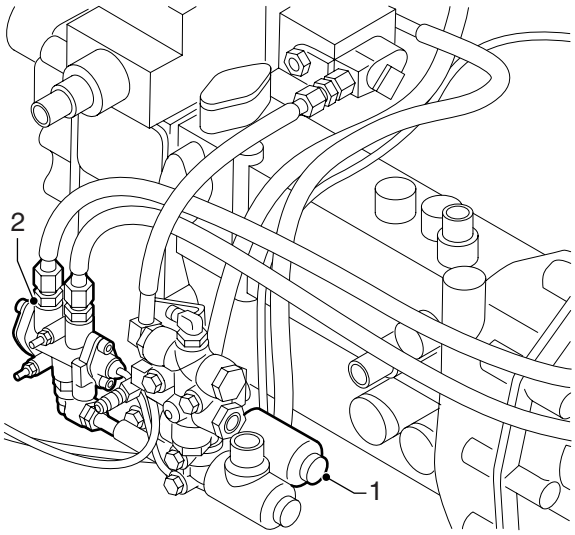


V300141

3. Downshift protection valve
At the left-hand side of the gearbox.

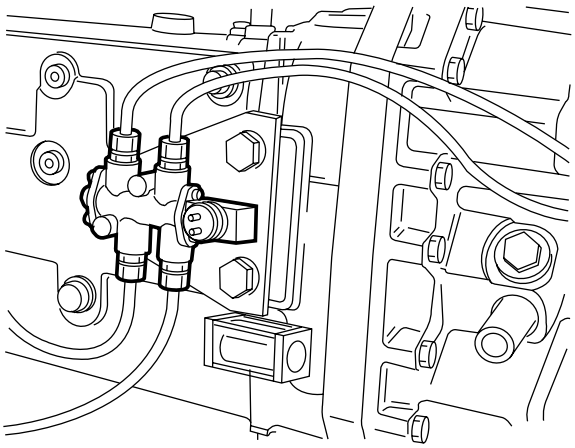
Version *CF*75, production date < 2003-21

1. Electropneumatic downshift protection valve
2. Pneumatic downshift protection valve

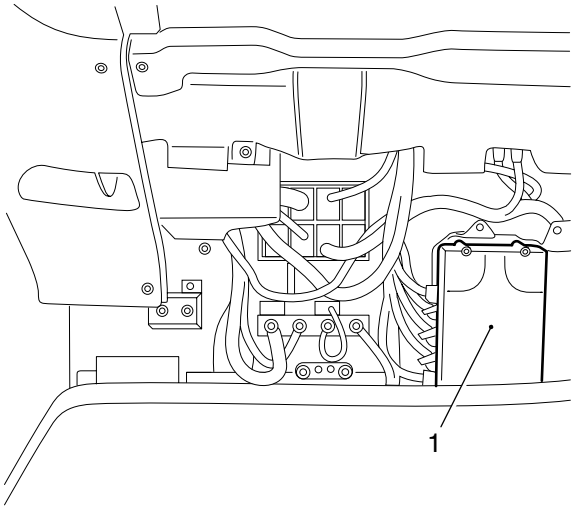


V300879

Version *CF*75, production date ≥ 2003-21

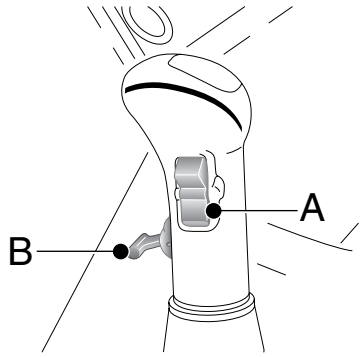

V 300029

4. VIC electronic unit
In the central box on the co-driver's side (1).



V300418

5. Gear lever range-change switch
Rocker switch (B) at the front of the gear lever.

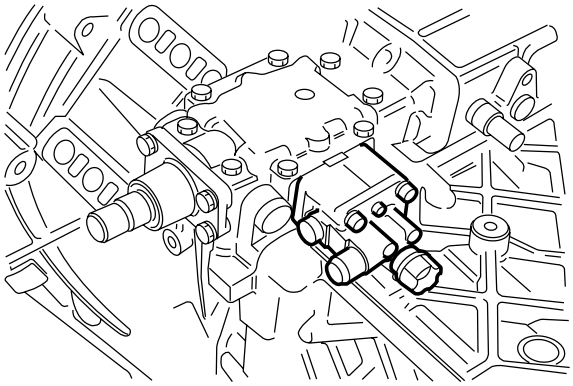


D000096

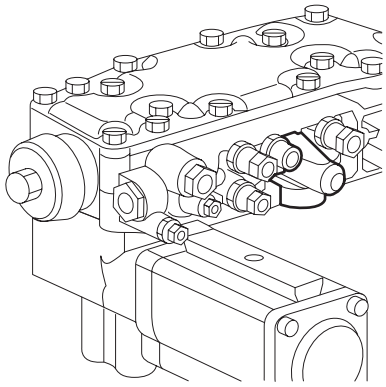
ZF gearboxes ZF 8/16S-151/181/221

1. Neutral position valve
At the side of the selector shaft housing on the gearbox.

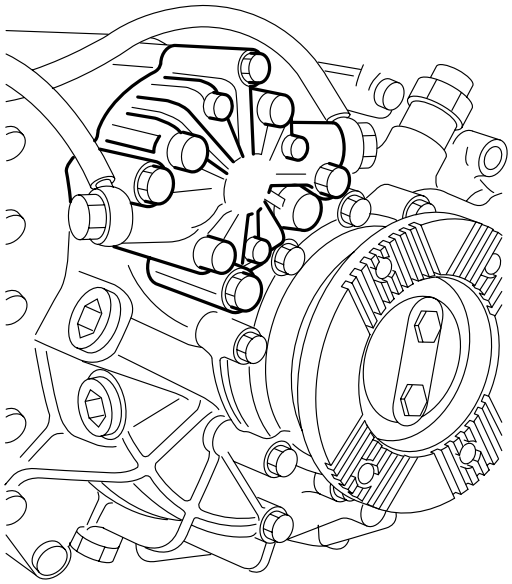
With separate air distribution block:


V300140

With integrated air distribution block:
Integrated in the middle of the air distribution block.


V300862

2. Range-change gear engaging cylinder
At the back of the gearbox.

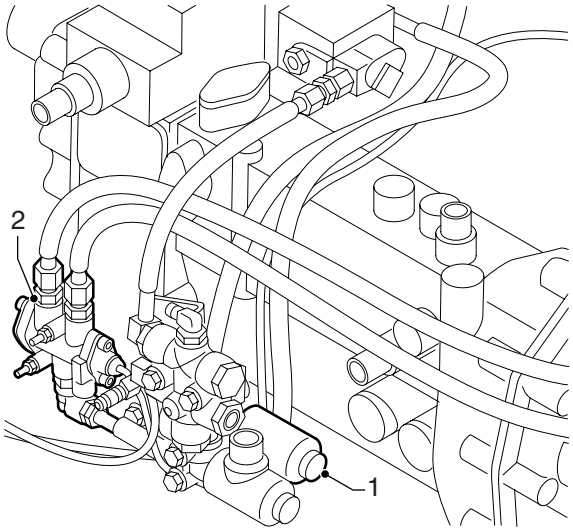


V300141

3. Downshift protection valve
At the left-hand side of the gearbox.

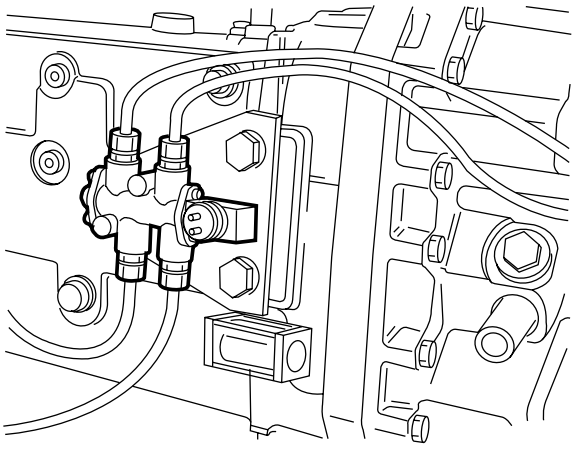
Version *CF*75/85, production date < 2003-21

1. Electropneumatic downshift protection valve
2. Pneumatic downshift protection valve



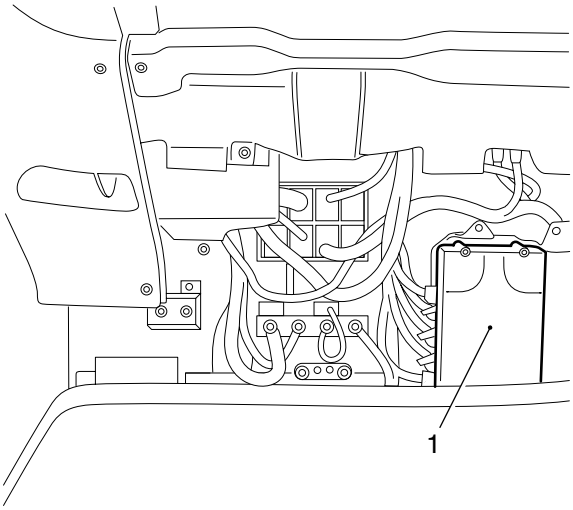
V300879

Version *CF*75/85, production date ≥ 2003-21



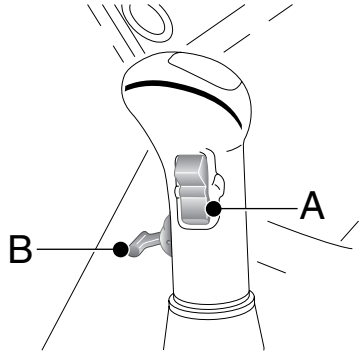
V 300029

4. VIC electronic unit
In the central box on the co-driver's side (1).



V300418

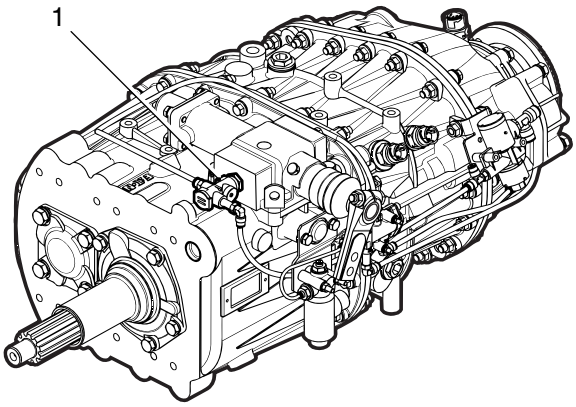
5. Gear lever range-change switch
Rocker switch (B) at the front of the gear lever.



D000096

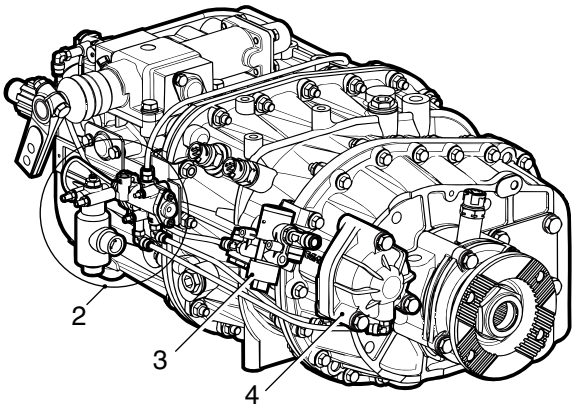
Eaton FS/6309A gearbox

1. Neutral position valve (1)
At the side of the gearbox.



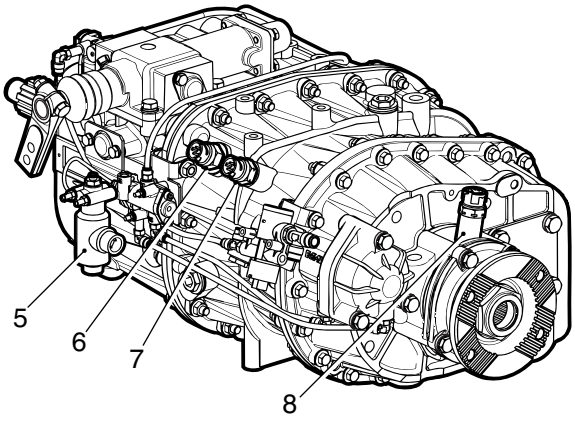
V300451

2. **Electropneumatic downshift valve (2)**
   At the side of the gearbox.
3. **Filter/governor (3)**
   At the side of the gearbox.
4. **Range-change gear engaging cylinder (4)**
   At the side of the gearbox.



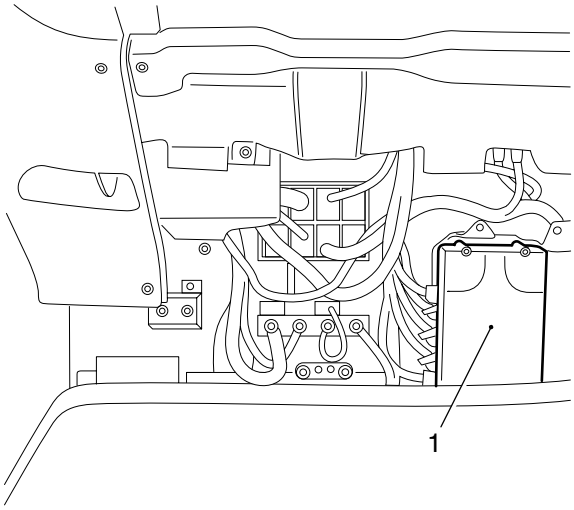
V300452

5. **Reversing switch (6)**
   At the side of the gearbox.
6. **Neutral switch (7)**
   At the side of the gearbox.
7. **Speed sensor (8)**
   At the rear of the gearbox.



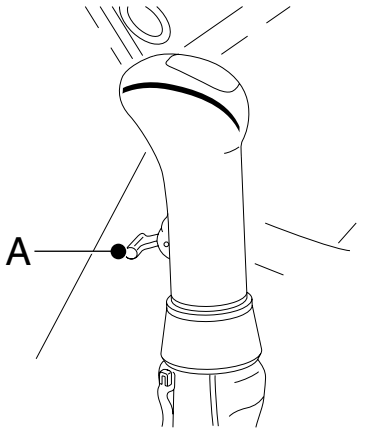
V300453

8. **VIC electronic unit**
   In the central box on the co-driver's side (1).



V300418

9. Gear lever range-change switch
Rocker switch (A) at the front of the gear lever.



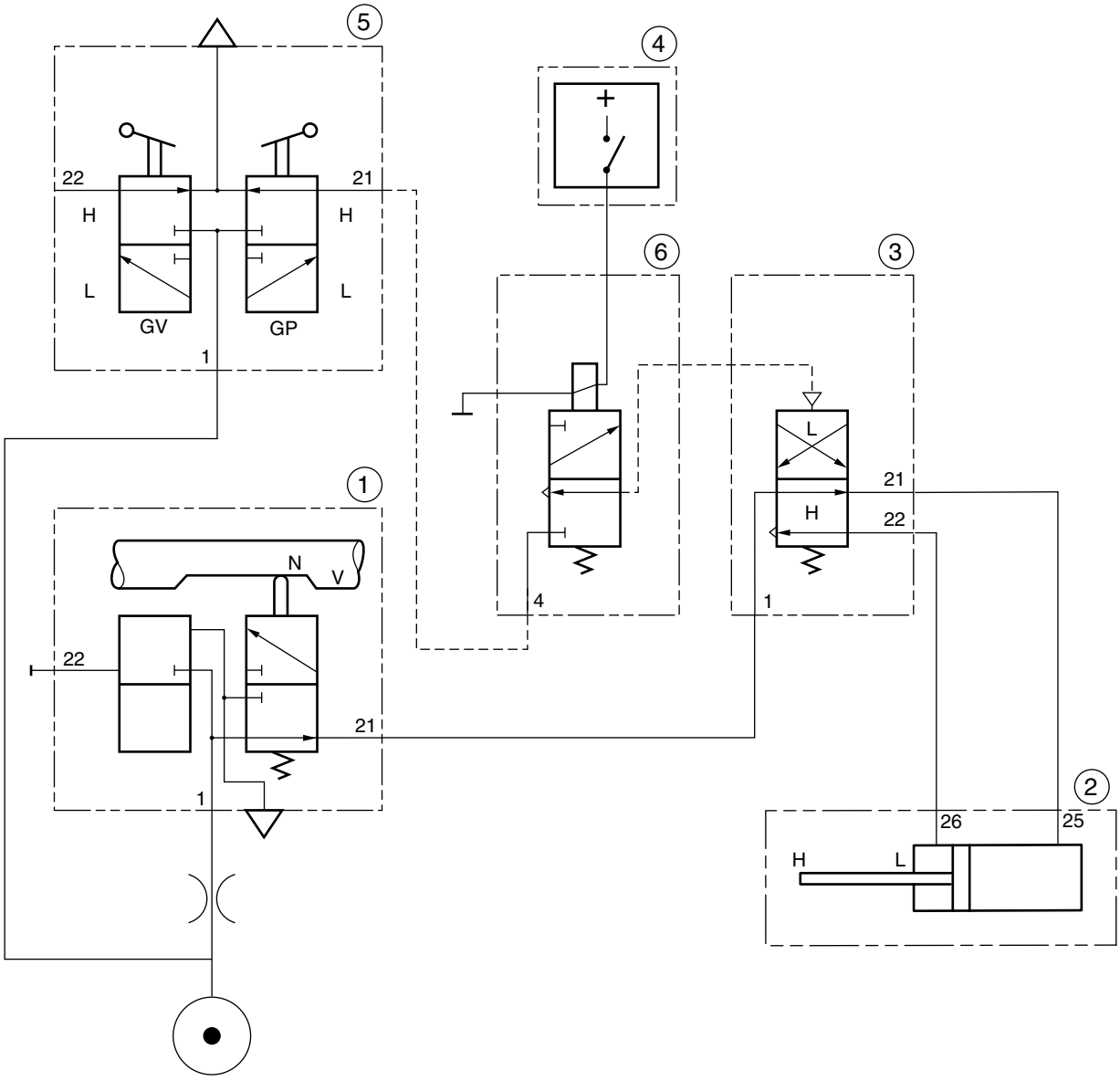
1.2 SYSTEM DESCRIPTION, DOWNSHIFT PROTECTION

The downshift protection prevents shifting down from the gearbox high range to the low range when the vehicle speed is too high.
Shifting down from the high to the low range when the vehicle speed is too high could cause serious damage to the clutch plate, gearbox and engine because of the reduction in the range-change gear.

The protection is enabled automatically when the vehicle speed exceeds a certain pre-programmed value. This vehicle speed (speed signal) is programmed in the VIC.

Function, downshift protection of ZF gearboxes

Version *CF*75/85, production date < 2003-21



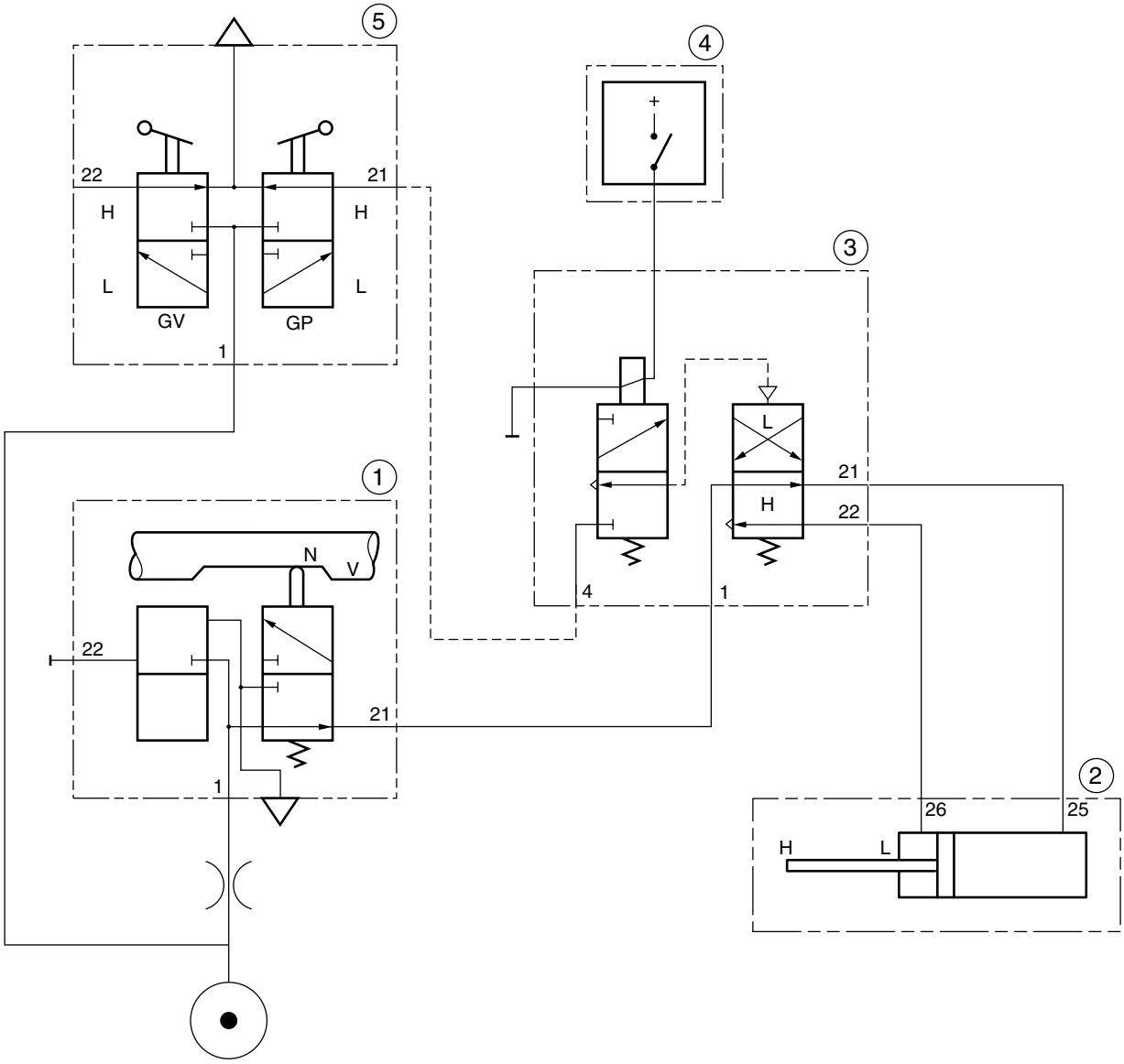
V300369

If the range-change switch (5) on the gear lever is shifted to the low-range preference, the “GP” air-pressure valve will switch through to connection point 21. This air pressure is now applied to connection point 4 of the electropneumatic valve (3).
If the vehicle speed exceeds a particular value, the electronic unit (4) will interrupt the connection between the electropneumatic valve (3) and the power supply.

Regardless of any pneumatic command from the gear lever range-change switch (5), it is now no longer possible to switch an air pressure to connection point 26 of the engaging cylinder (2) and hence to shift to the low range.

Note:
The air supply to the electropneumatic valve (6) is only available when the gear lever, and hence also the neutral position valve (1), is in the neutral position (N).

Version *CF*75, production date ≥ 2003-21



V300711

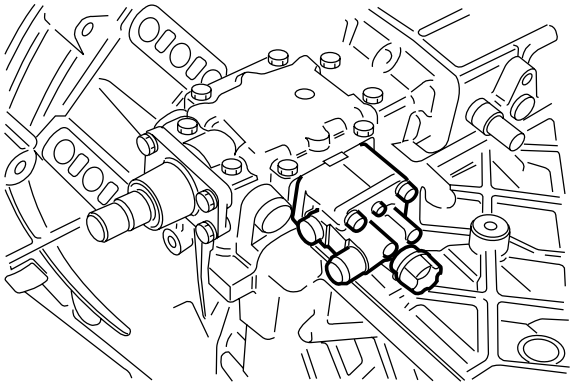
If the range-change switch (5) on the gear lever is shifted to the low-range preference, the “GP” air-pressure valve will switch through to connection point 21. This air pressure is now applied to connection point 4 of the electropneumatic valve (3).
If the vehicle speed exceeds a particular value, the electronic unit (4) will interrupt the connection between the electropneumatic valve (3) and the power supply.

Regardless of any pneumatic command from the gear lever range-change switch (5), it is now no longer possible to switch an air pressure to connection point 26 of the engaging cylinder (2) and hence to shift to the low range.

Note:
The air supply to the electropneumatic valve (3) is only available when the gear lever, and hence also the neutral valve (1), is in the neutral position (N).

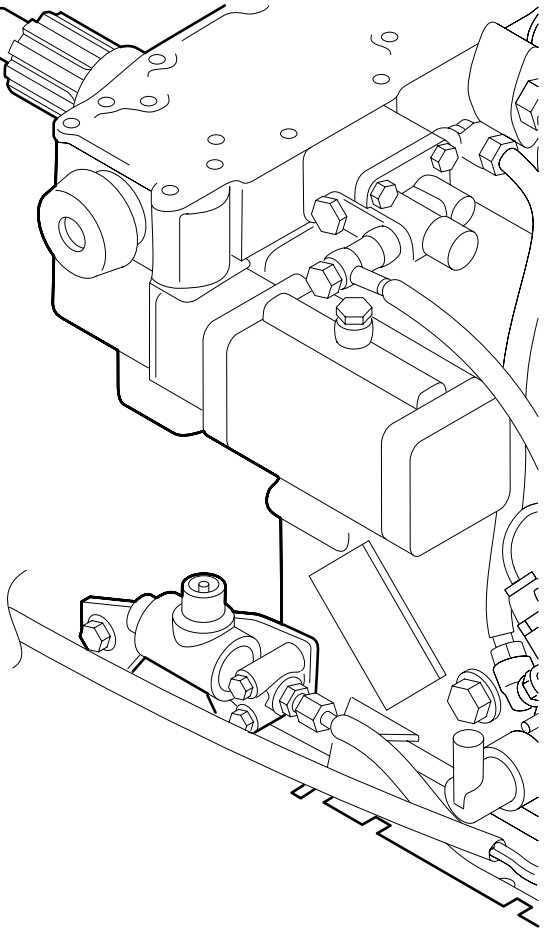
1.3 LOCATION OF GATE PROTECTION COMPONENTS

1. **Neutral position valve**
   At the side of the selector shaft housing on the gearbox.



V300140

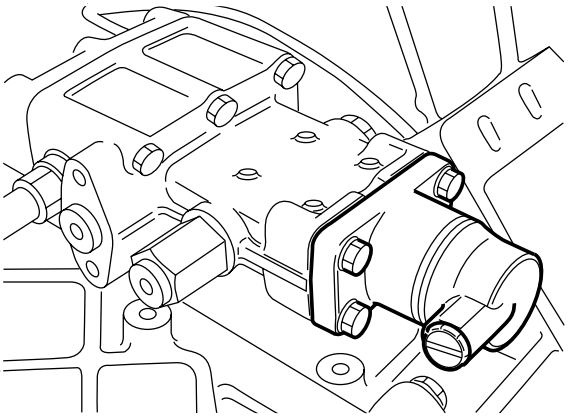
2. **Gate protection valve**
   At the left-hand or right-hand side of the gearbox (depending on the vehicle type).



V300714

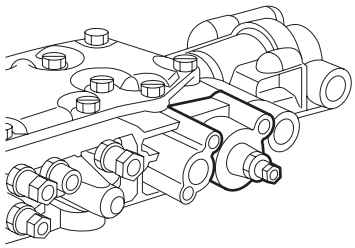
© 200337

3. Locking cylinder
With separate air distribution block:
at the rear of the selector shaft housing.



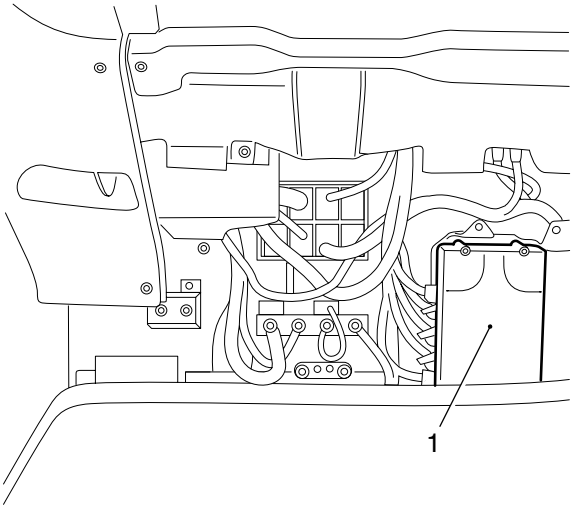
V300002

With integrated air distribution block:
at right angles to the selector shaft housing



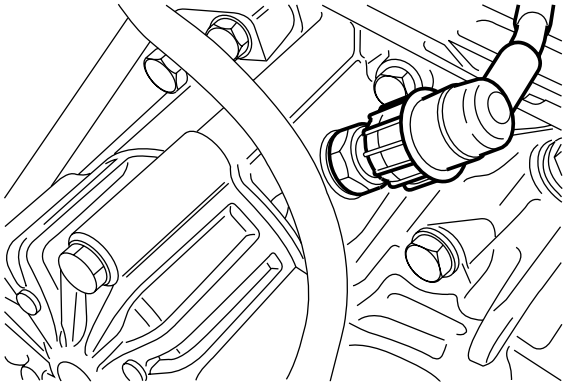
V300861

4. VIC electronic unit
The electronic unit (1) is under the central box on the co-driver's side.



V300418

5. Low-range switch
Located at the rear of the gearbox.

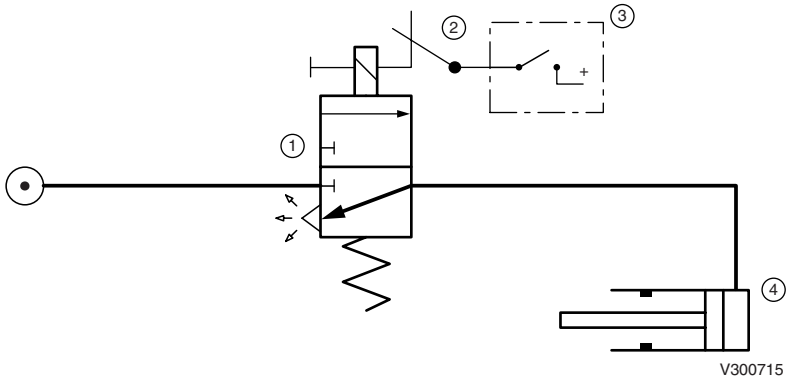


V300005

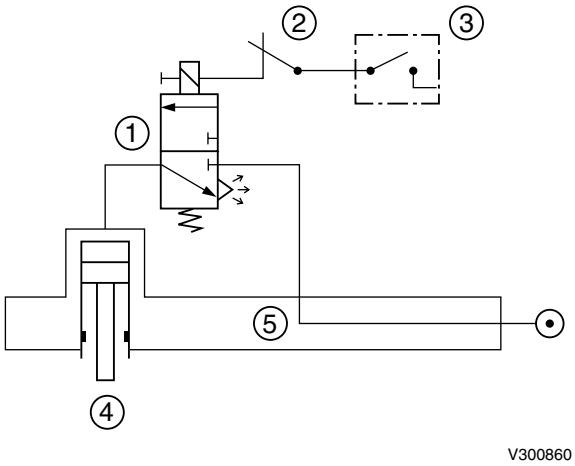
© 200337

1.4 SYSTEM DESCRIPTION, GATE PROTECTION

How gate protection works



Situation with separate air distribution block



Situation with integrated air distribution block

The gate protection only operates in the low range. The low range is registered by the low-range switch (2). It prevents shifting from third or fourth gear (gate 3-4) to first or second gear (gate 1-2) if the vehicle speed is too high.

This shifting error occurs if the driver fails to use the range-change gear at the front of the gear lever to switch to the high range before shifting from fourth to fifth gear.

The moment when the protection is engaged is determined by the VIC electronic unit (3).
The moment when the protection is engaged is dependent on the vehicle speed signal.

The gate protection valve (1) is energised if the following conditions are met:
The vehicle speed is above the set speed, i.e. the VIC electronic unit (3) supplies voltage to the low-range switch (2).
The low-range switch (2) is closed if the gearbox is shifted to the low range.

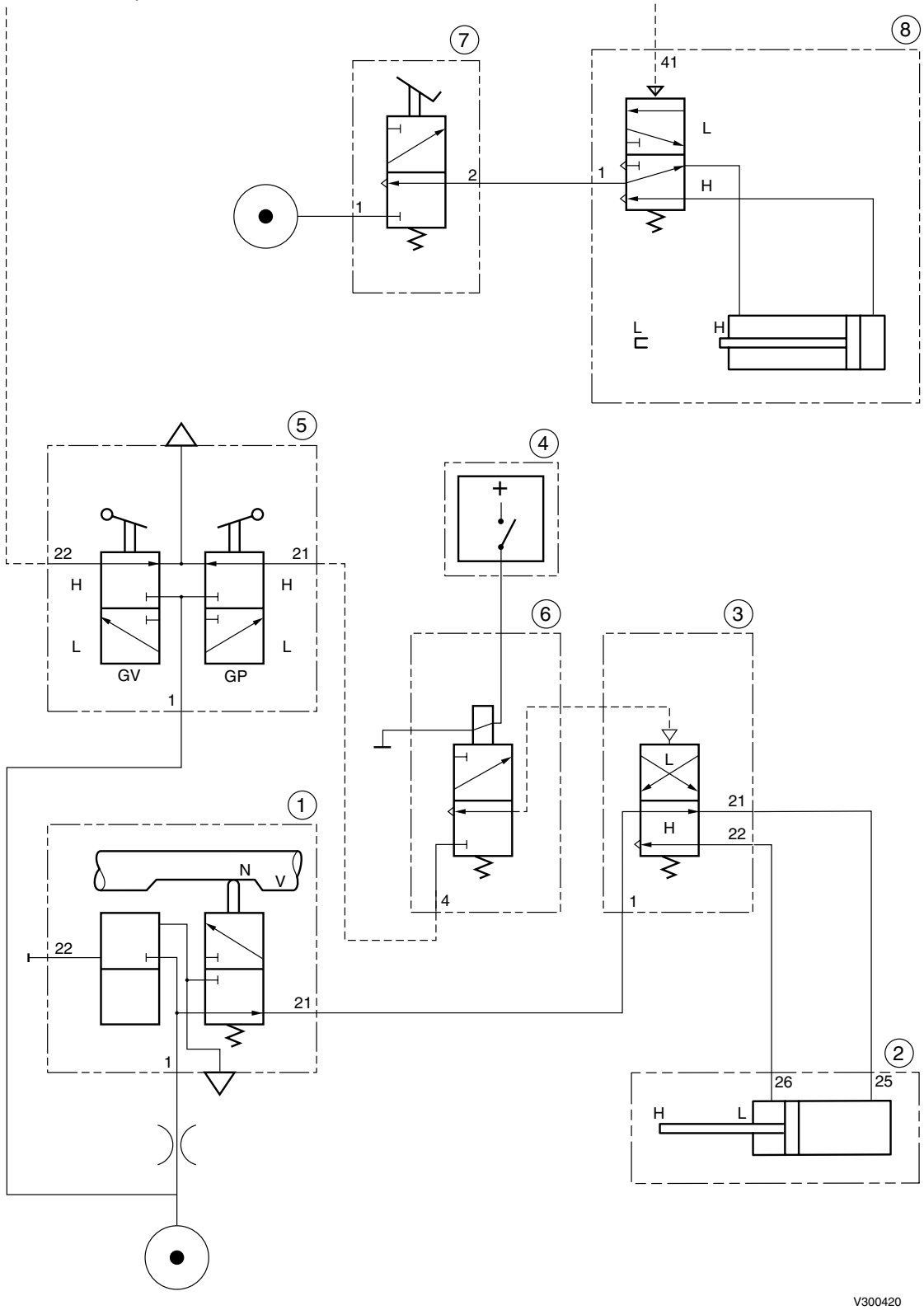
Pressure is sent to the locking cylinder (4) via the electronic gate protection valve (1). As a result, gate 1-2 can no longer be engaged. In the case of a gearbox with a separate air distribution block, the locking cylinder is mounted at the back of the selector housing. In the case of a gearbox with an integrated air distribution block, the locking cylinder is mounted at right angles to the selector housing. However, if the high range is selected, the gate protection valve (1) can no longer be energised as the low-range switch (2) has been opened. Gate 5-6 (1-2) can then again be engaged.

Note:
For reasons of safety, downshifting must always be possible. Hence, by exerting additional shifting power, it is still possible to reach gate 1-2 against the pressure of the locking cylinder.

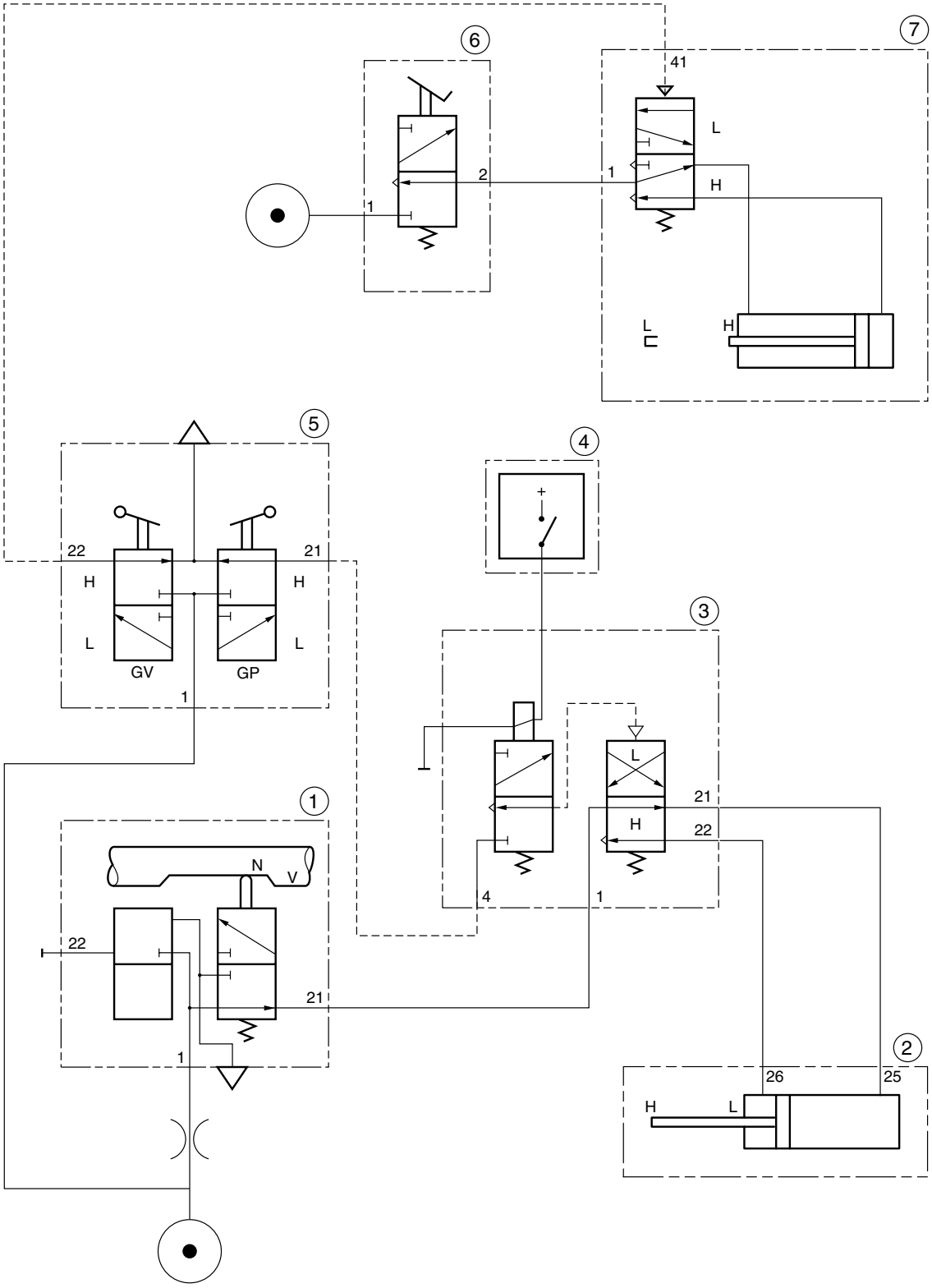
1.5 PNEUMATIC DIAGRAM, GEARBOX CONTROL

Pneumatic diagram of 16 S Direct Drive

Version *CF*75/85, production date < 2003-21

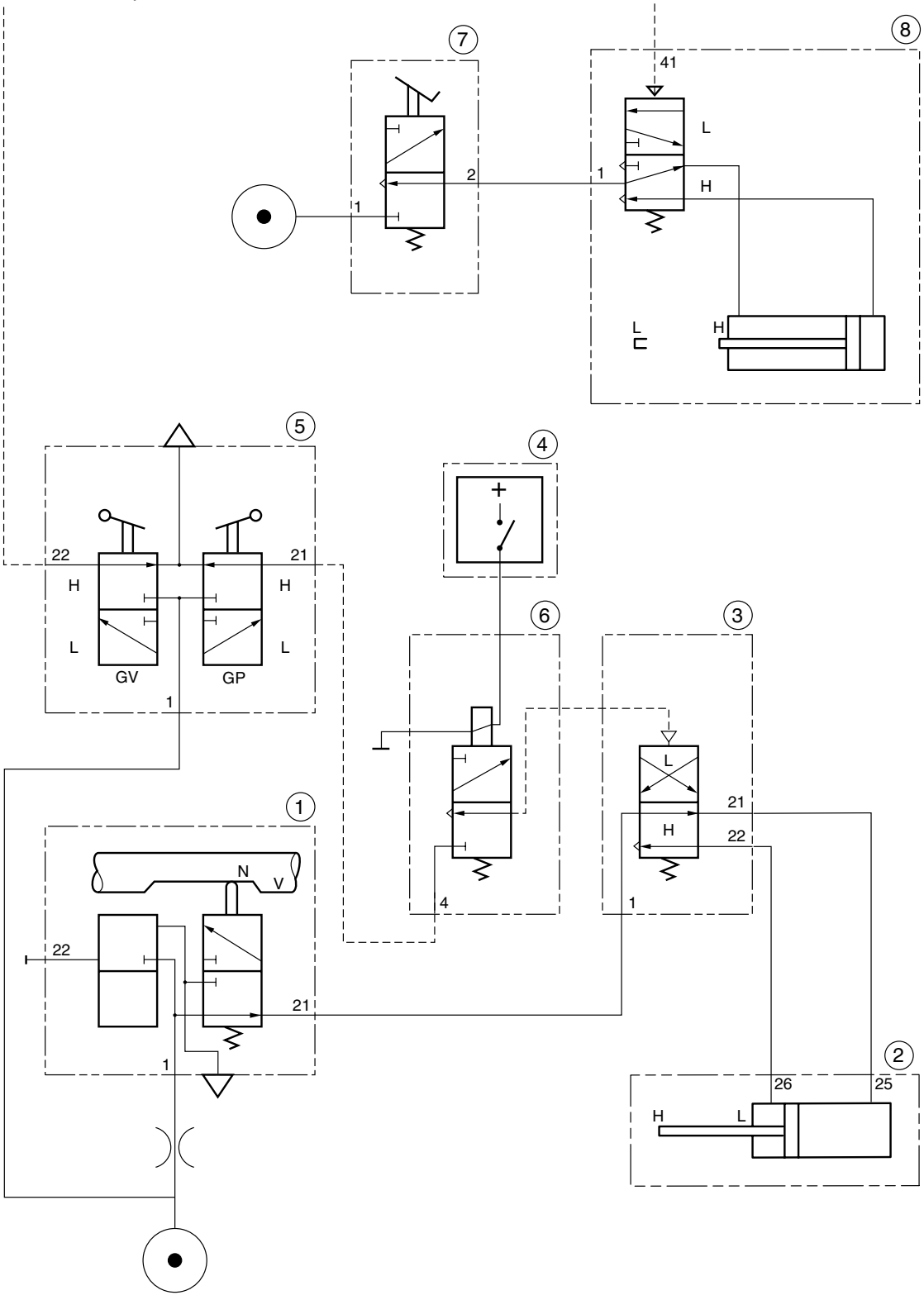


Version *CF*75/85, production date ≥ 2003-21

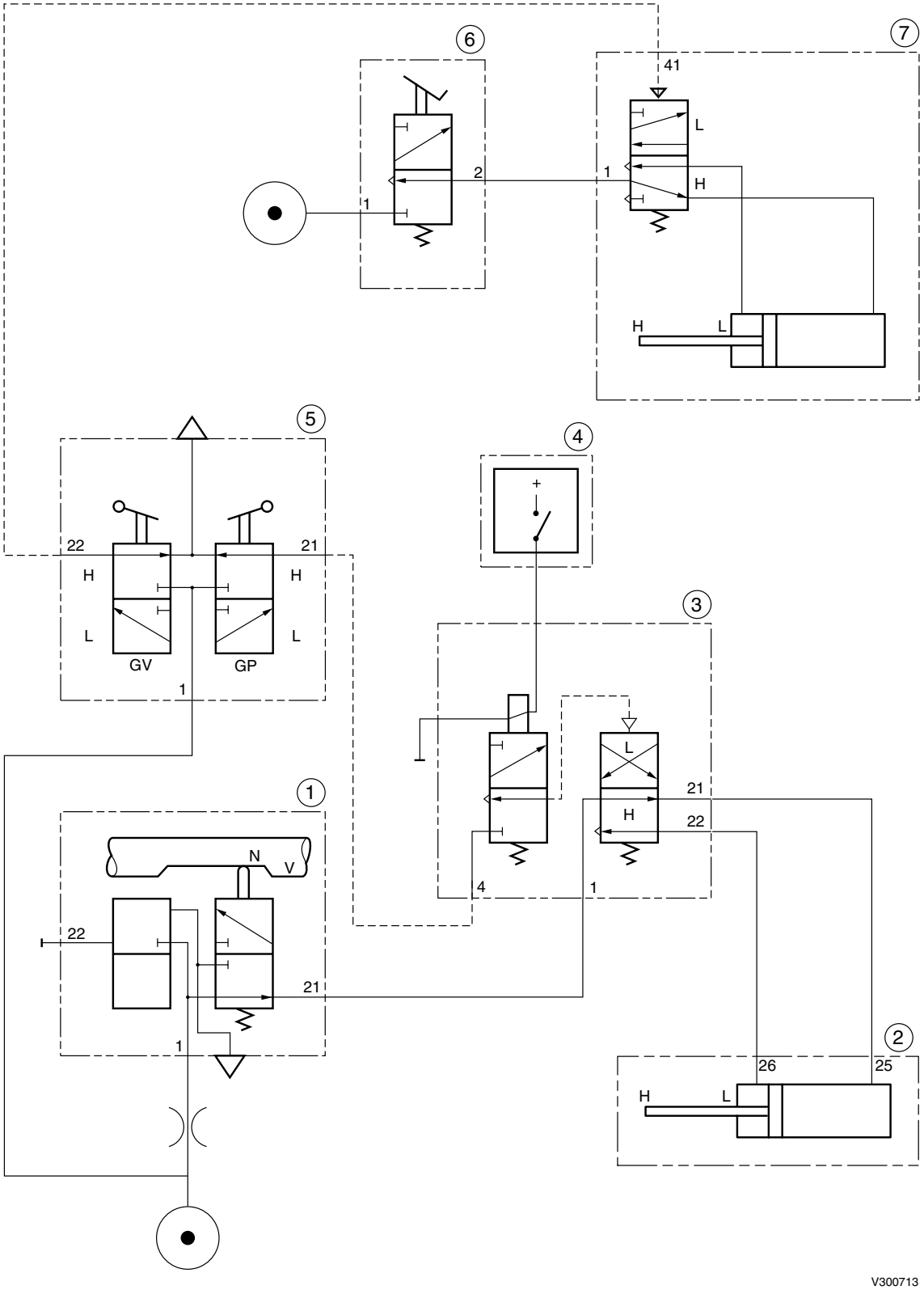


Pneumatic diagram of 16 S Overdrive

Version *CF*75/85, production date < 2003-21



Version *CF*75/85, production date ≥ 2003-21



The following applies to pneumatic diagram V300420 and V300421:

NOTE:
The mechanical position of the splitter switch engaging cylinder (Low (L) and High (H)) depends on the gearbox version: direct drive or overdrive.

The gear lever (5) has two switches, one for the splitter group (GV) and one for the range group (GP). Both switches are ventilated through connection 1 of the gearbox lever (5).

During a splitter switch, connection point 22 and connection point 41 of the splitter relay valve (8) are ventilated. As a result, the splitter relay valve will be pushed into the low (L) position. When the clutch pedal is fully depressed, the splitter relay valve will be connected to the air supply via connection 2 of the GV valve (7).
The splitter cylinder (8) is switched to the low (L) position.
If the GV switch (5) is then returned to the high (H) position, connection 41 of the splitter relay valve (8) will be bled via connection point 22 of the gear lever (5). As a result of the disappearance of the air pressure at connection 41, the splitter relay valve will move to the high (H) position. When the clutch is operated, the GV valve (7) will again connect the air supply to connection point 1 of the splitter relay valve (8).

This causes the splitter cylinder to move to the low (L) position.
The rear-mounted range box (range group) is operated via the GP switch (5). When the GP switch (5) is operated, the air supply will be connected to connection point 4 of the electropneumatic valve (6) of the downshift protection.

When the gearbox is in neutral, the air supply is connected via connection point 21 of the neutral position valve (1) to connections 1 and 21 of the downshift protection valve (3). If the GP switch (5) is moved to the high (H) position, the range-change gear engaging cylinder (2) is ventilated via connection 25, causing the range-change gear engaging cylinder to be moved to the high (H) position. The range-change gear engaging cylinder (2) is bled through connection point 26 and connection point 22 of the downshift protection valve (3).
If the GP switch (5) is moved to the low (L) position, the range-change gear engaging cylinder (2) is ventilated via connection 26, causing the range-change gear engaging cylinder to be moved to the low (L) position.
If the vehicle speed is lower than a certain value, the electronic unit (4) will supply voltage to the electropneumatic valve (6) of the downshift protection. This causes the electropneumatic valve to move to a different position. The air supply of the GP switch (5) is now connected to the pneumatic valve (3).
It is now possible to switch the pneumatic command from the gear lever range-change switch (5) by means of connection point 26 of the engaging cylinder (2) and hence to shift to the low range.

The following applies to pneumatic diagram V300712 and V300713:

NOTE:
The mechanical position of the splitter switch engaging cylinder (Low (L) and High (H)) depends on the gearbox version: direct drive or overdrive.

The gear lever (5) has two switches, one for the splitter group (GV) and one for the range group (GP). Both switches are ventilated through connection 1 of the gearbox lever (5).

During a splitter switch, connection point 22 and connection point 41 of the splitter relay valve (7) are ventilated. As a result, the splitter relay valve will be pushed into the low (L) position. When the clutch pedal is fully depressed, the splitter relay valve will be connected to the air supply via connection 2 of the GV valve (6).
The splitter cylinder (7) is switched to the low (L) position.
If the GV switch (5) is then returned to the high (H) position, connection 41 of the splitter relay valve (7) will be bled via connection point 22 of the gear lever (5). As a result of the disappearance of the air pressure at connection 41, the splitter relay valve will move to the high (H) position. When the clutch is operated, the GV valve (7) will again connect the air supply to connection point 1 of the splitter relay valve (7).

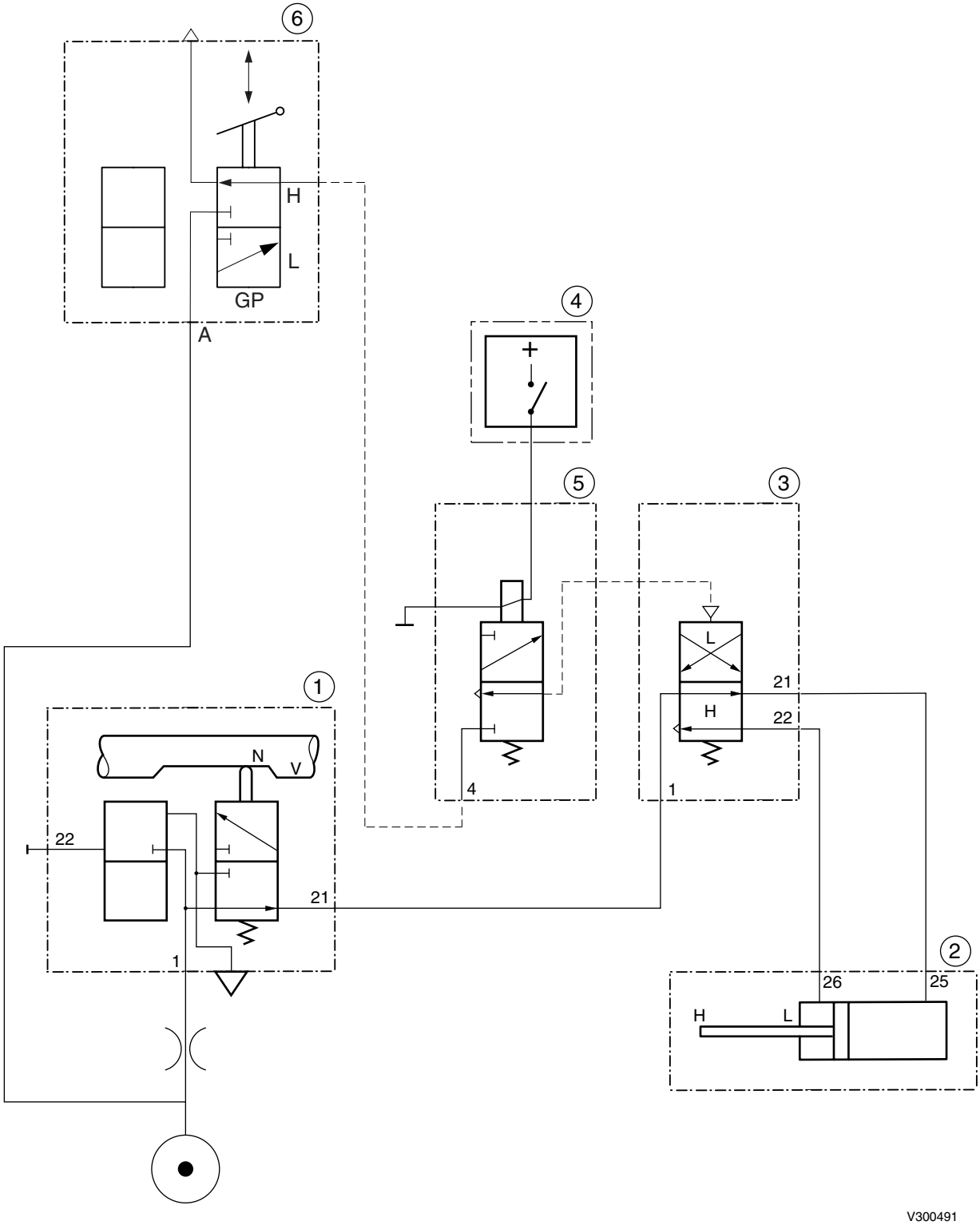
This causes the splitter cylinder to move to the low (L) position.
The rear-mounted range box (range group) is operated via the GP switch (5). When the GP switch (5) is operated, the air supply will be connected to connection point 4 of the downshift protection valve (3).
When the gearbox is in neutral, the air supply is connected via connection point 21 of the neutral position valve (1) to connections 1 and 21 of the downshift protection valve (3). If the GP switch (5) is moved to the high (H) position, the range-change gear engaging cylinder (2) is ventilated via connection 25, causing the range-change gear engaging cylinder to be moved to the high (H) position. The range-change gear engaging cylinder (2) is bled through connection point 26 and connection point 22 of the downshift protection valve (3).

If the GP switch (5) is moved to the low (L) position, the range-change gear engaging cylinder (2) is ventilated via connection 26, causing the range-change gear engaging cylinder to be moved to the low (L) position.

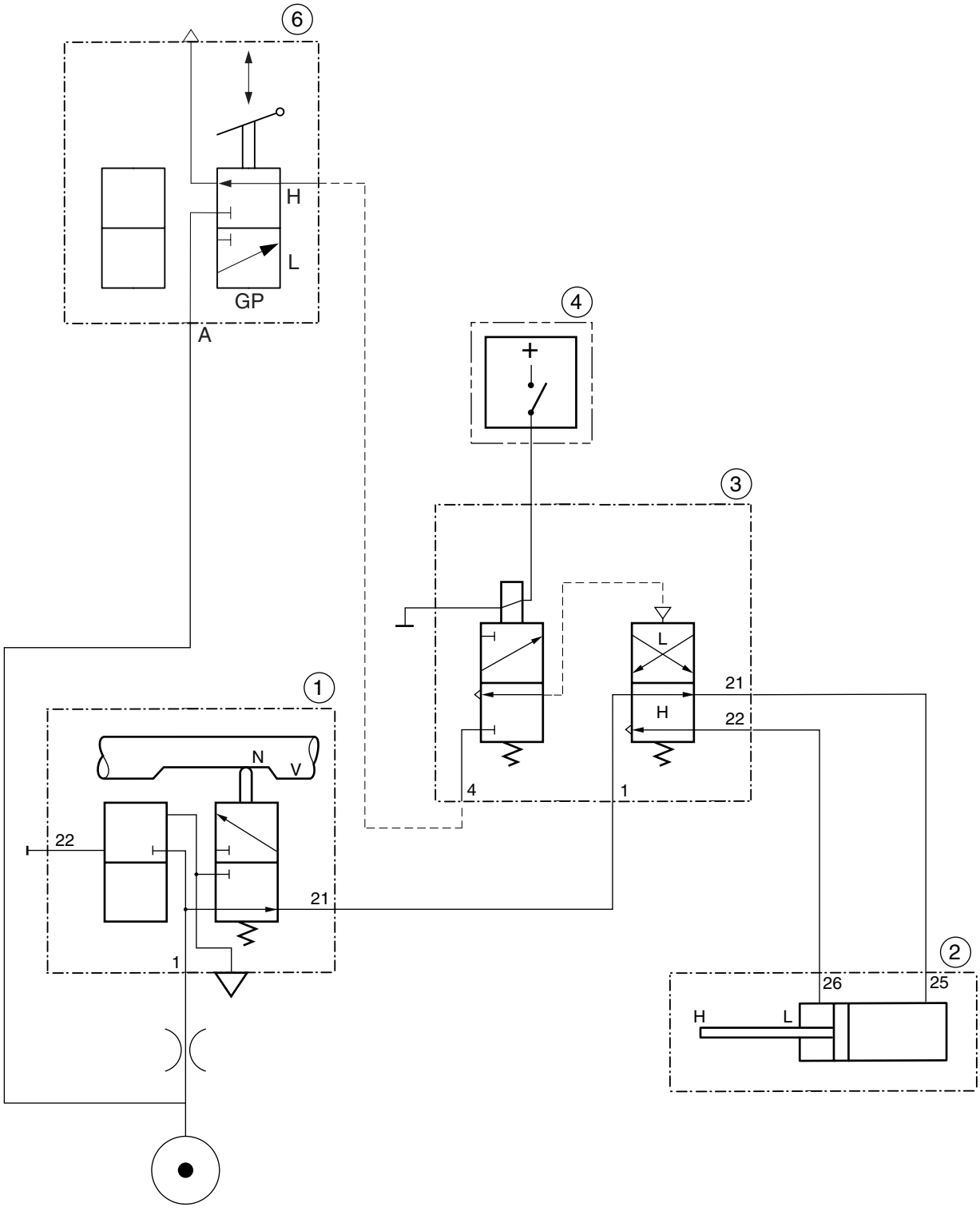
If the vehicle speed is lower than a certain value, the electronic unit (4) will supply voltage to the downshift protection valve (3). This causes the electropneumatic valve to move to a different position.
The air supply of the GP switch (5) is now connected to the pneumatic valve.
It is now possible to switch the pneumatic command from the gear lever range-change switch (5) by means of connection point 26 of the engaging cylinder (2) and hence to shift to the low range.

Pneumatic diagram of 8/9 S Direct Drive

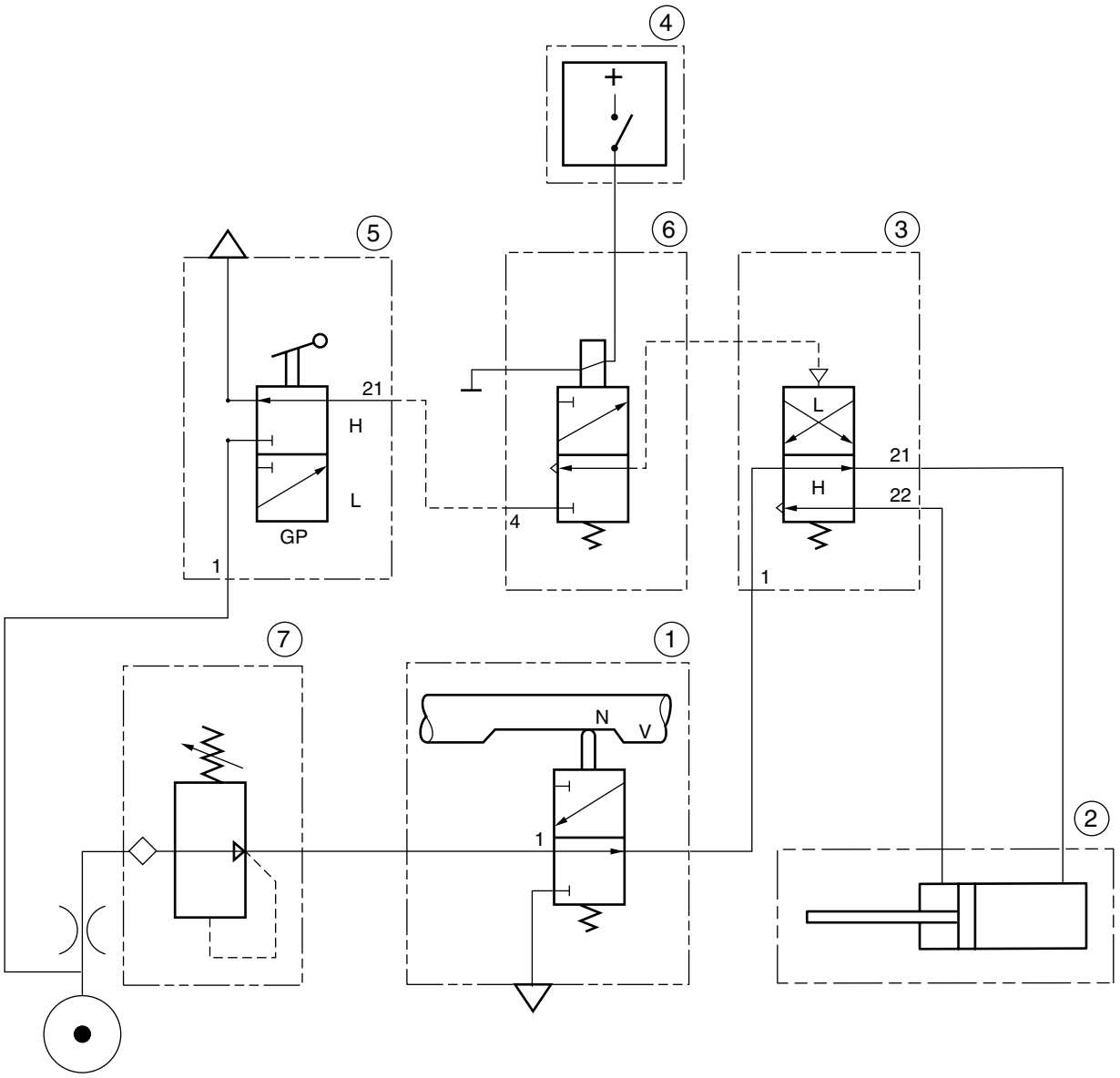
Version *CF*75, production date < 2003-21



Version *CF*75, production date ≥ 2003-21



Pneumatic diagram, Eaton FS/6309A



4

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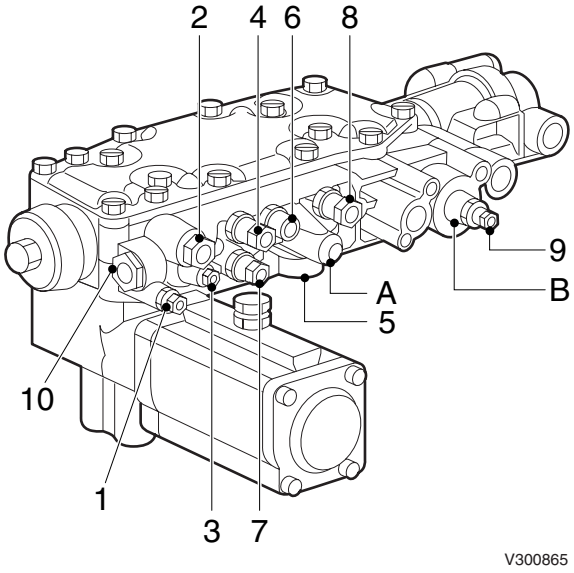
2. DESCRIPTION OF COMPONENTS

2.1 INTEGRATED AIR DISTRIBUTION BLOCK

There are two ways in which the air for the gearbox control unit can be distributed:
- With a separate air distribution block at the side of the gearbox
- With an integrated air distribution block on the selector housing.

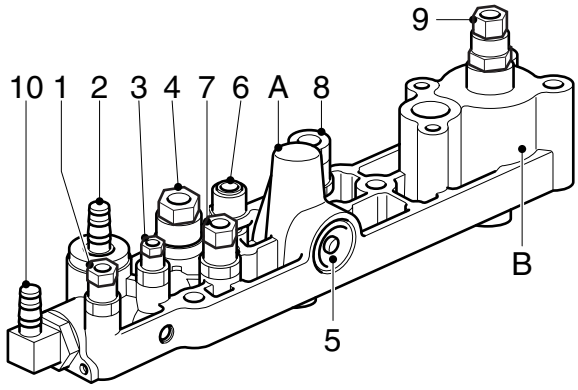
The integrated air distribution block has a single central connection for the air supply (10), from which all components are provided with air. The neutral position valve (A) and the locking cylinder (B) are also integrated in the air distribution block.



Rear view of integrated air distribution block

Connection points on integrated air distribution block:
1. Connection to PTO
2. Connection to intarder
3. Gear lever air supply
4. Connection to clutch servo
5. Neutral position valve bleed opening
6. Servoshift air supply for 8S gearbox
7. Connection to gate protection valve
8. Connection to downshift protection valve
9. Connection from gate protection valve
10. Central air supply

A. Neutral position valve (integrated)
B. Locking cylinder



Bottom view of integrated air distribution block

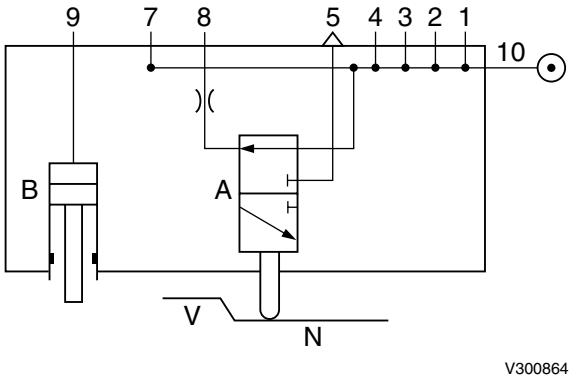
4

Schematic representation of integrated air distribution block:

Connection points on integrated air distribution block:
1. Connection to PTO
2. Connection to intarder
3. Gear lever air supply
4. Connection to clutch servo
5. Neutral position valve bleed opening
6. Servoshift air supply for 8S gearbox
7. Connection to gate protection valve
8. Connection to downshift protection valve
9. Connection from gate protection valve
10. Central air supply

A. Neutral position valve (integrated)
B. Locking cylinder

N Gearbox selector shaft in neutral
V Gearbox selector shaft engaged



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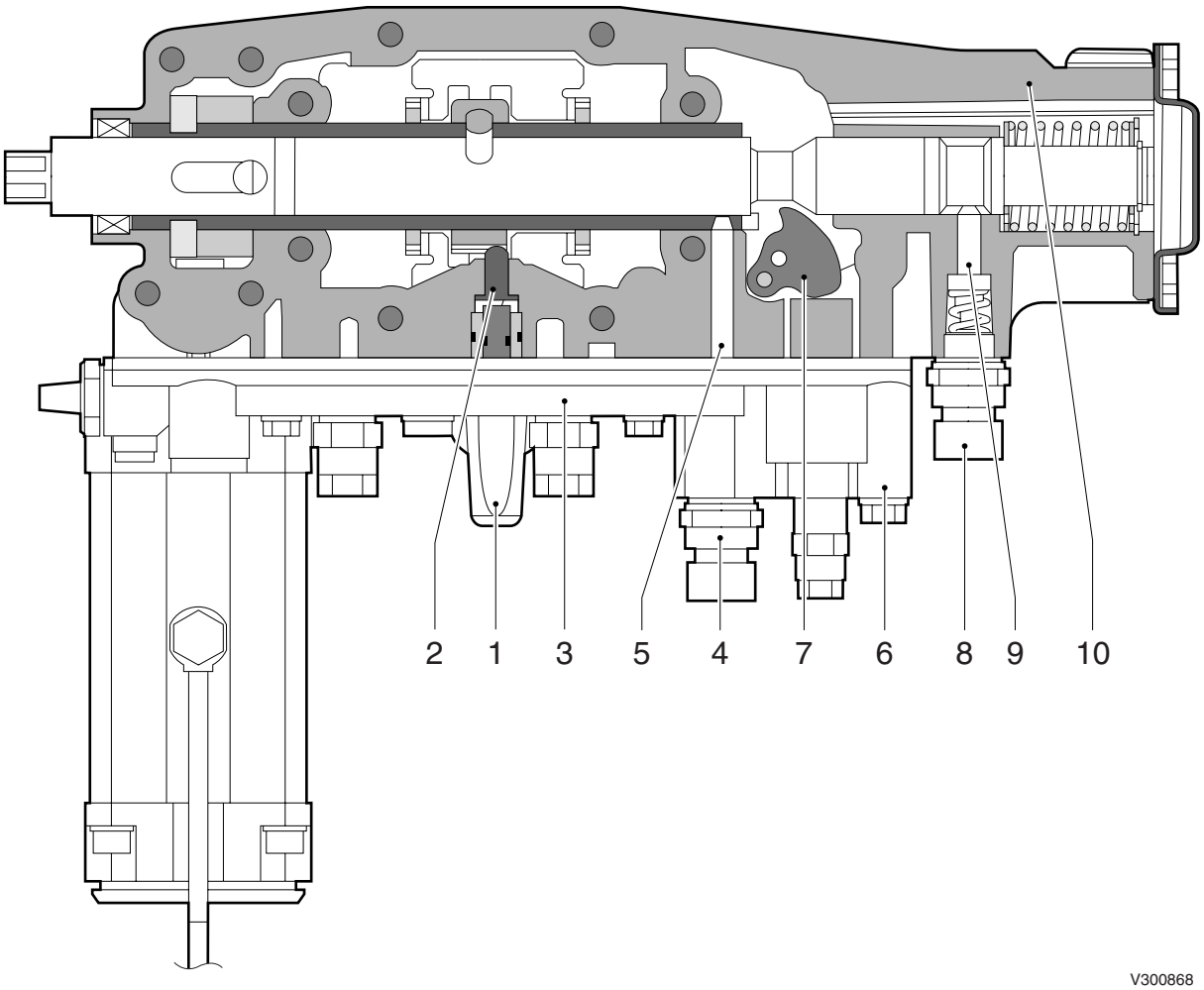
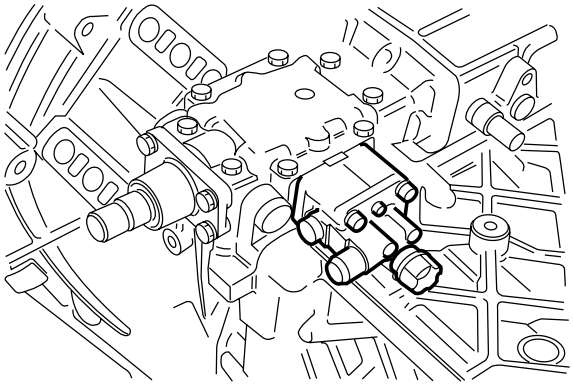
Sectional drawing of integrated air distribution block:



1. Neutral position valve
2. Neutral position valve attachment pin
3. Air distribution block
4. Neutral switch
5. Neutral position valve attachment pin
6. Locking cylinder
7. Locking cylinder lever
8. Reversing switch
9. Reversing switch attachment pin
10. Selector housing

2.2 NEUTRAL POSITION VALVE

Situation with separate air distribution block:

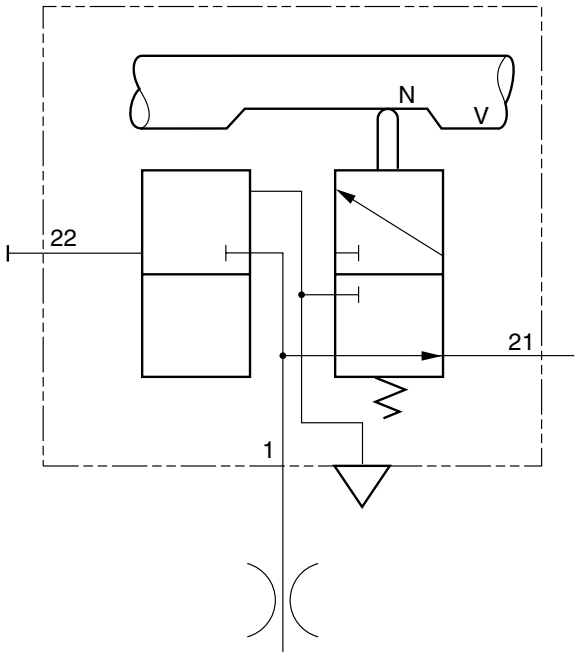


V300140

Pneumatic symbol

Connection point	Function
1	Supply
21	Cut-in pressure, range-change switch
22	Plugged

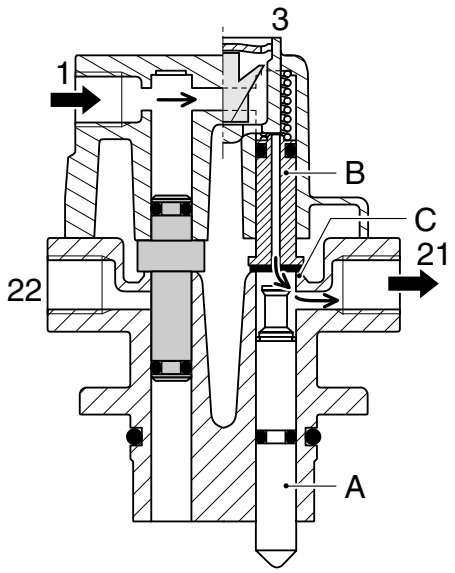
Position	Function
N	Gearbox selector shaft in neutral
V	Gearbox selector shaft engaged



V300160

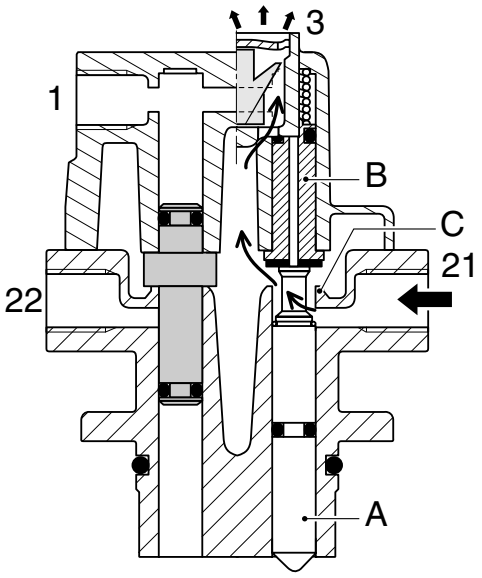
© 200337

Operation
Gearbox in neutral:
In the neutral position, thrust pin A will be pushed into a recess in the selector shaft by means of the air pressure coming from connection 1 and a bore hole through sealing pin B. Sealing pin B will provide a spring-loaded seal on seat C. The air flow can now leave the valve via connection 21 and subsequently operate the range cylinder through the electropneumatic valve.



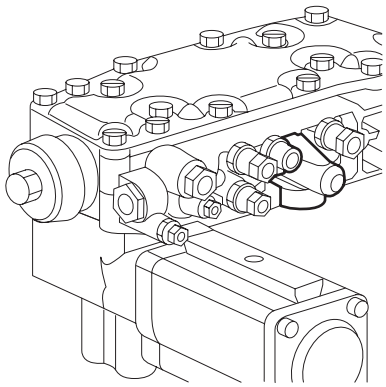
W 3 02 098

Gearbox engaged:
When a gear has been engaged, the selector shaft will push the thrust pin A up against sealing pin B. This closes off the bore hole in this pin and causes the pin to be lifted of seat C against the spring pressure. The air pressure in the gear engaging cylinder can now flow back to the neutral valve via the electropneumatic valve and leave the valve housing through the bleed opening (3).

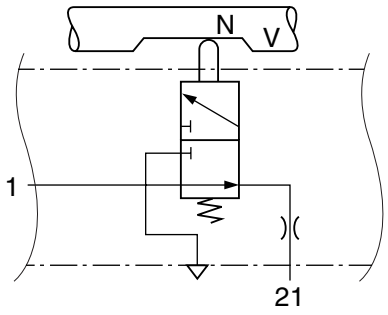


W 3 02 102

Situation with integrated air distribution block


V300862

Pneumatic symbol



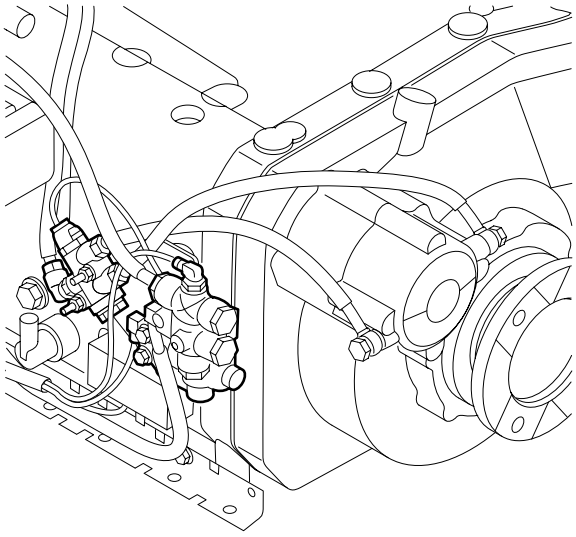
V300863

Connection point	Function
1	Supply
21	Cut-in pressure, range-change switch

Position	Function
N	Gearbox selector shaft in neutral
V	Gearbox selector shaft engaged

2.3 DOWNSHIFT PROTECTION VALVE

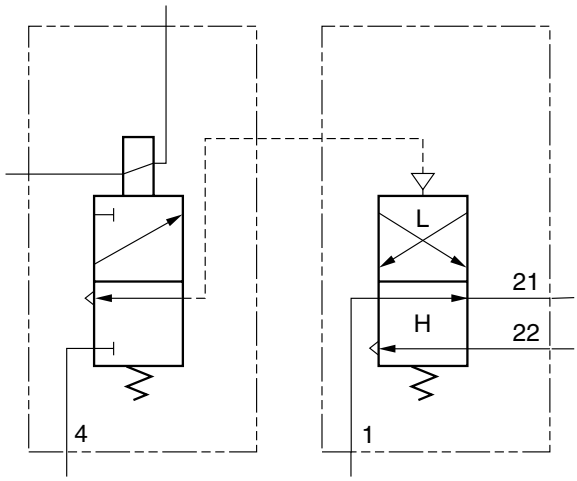
Version *CF*75/85, production date < 2003-21



V300428

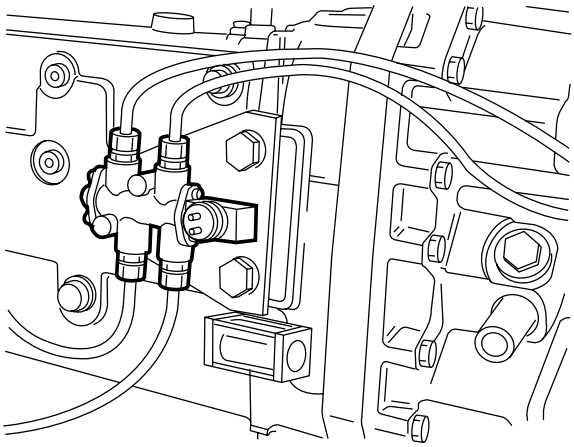
Pneumatic symbol

Connection point	Function
1	Supply
4	Control pressure
21	High-range cut-in pressure
22	Low-range cut-in pressure



V300424

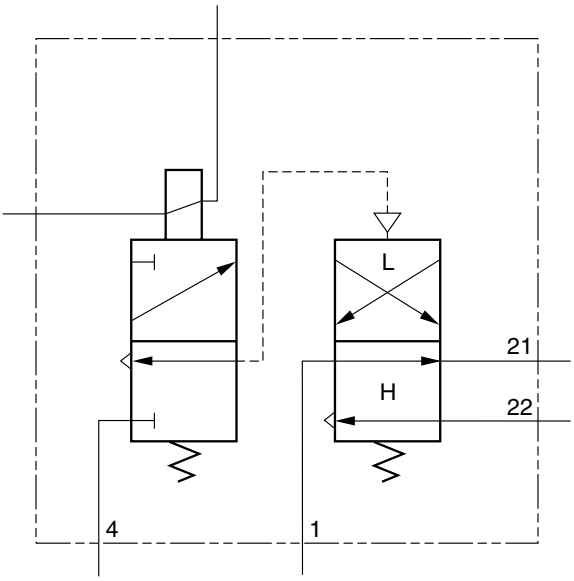
Version *CF*75/85, production date ≥ 2003-21



V 300029

Pneumatic symbol

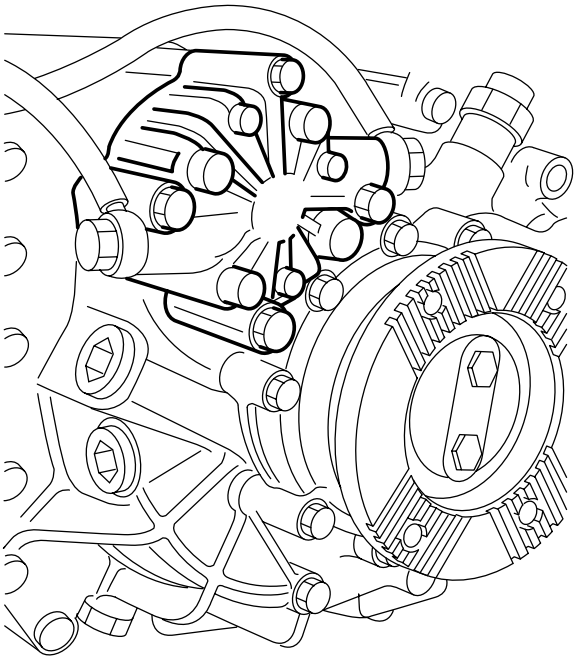
Connection point	Function
1	Supply
4	Control pressure
21	High-range cut-in pressure
22	Low-range cut-in pressure



V300144

Operation
If the vehicle speed exceeds a particular value, the coil of the electropneumatic valve is interrupted.
Regardless of any pneumatic command from the gear lever range-change switch to the connection point (4), it is now no longer possible to switch down to the lower range.
The air supply (1) to the electropneumatic valve is only available when the gear lever, and hence also the neutral position valve, is in the neutral position.

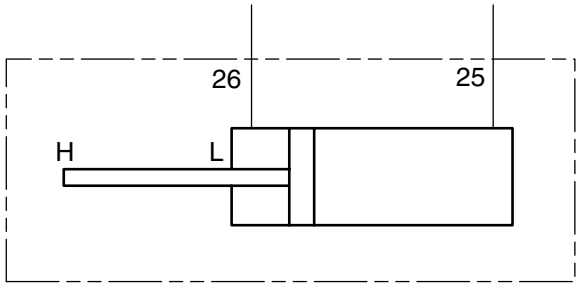
2.4 HIGH/LOW RANGE ENGAGING CYLINDER



V300141

Pneumatic symbol

Connection point	Function
25	Range-change gear high
26	Range-change gear low



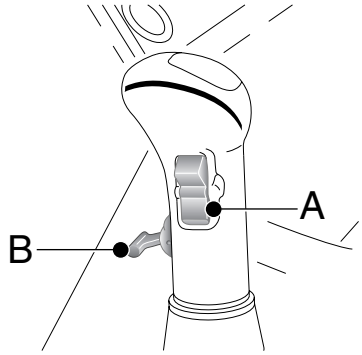
V300142

Operation
The engaging cylinder controlling the high/low section of the gearbox, receives its supply via the electropneumatic protection valve. This protection valve is operated by the selector valve on the gear lever. The gear engaging cylinder is located at the rear end of the gearbox.

2.5 GEAR LEVER SELECTOR VALVE

Splitter-range switch **A**

Range change gear **B**

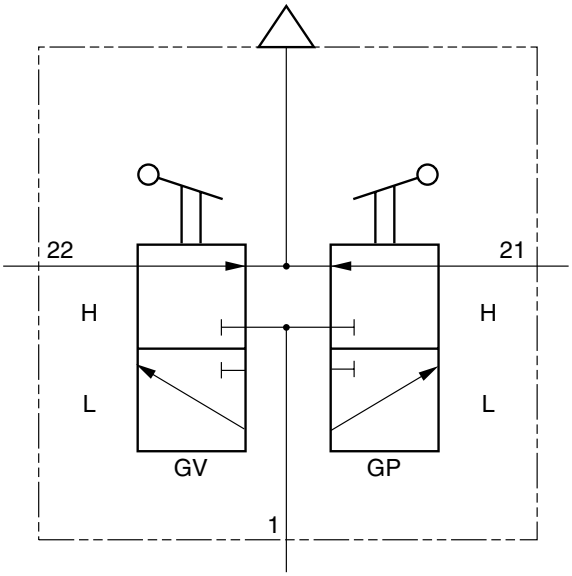


D000096

4

Pneumatic symbol

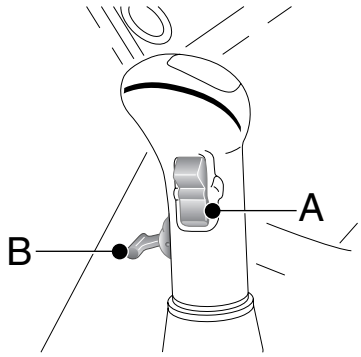
Position	Function
GP	Range-change gear
GV	Splitter



V300161

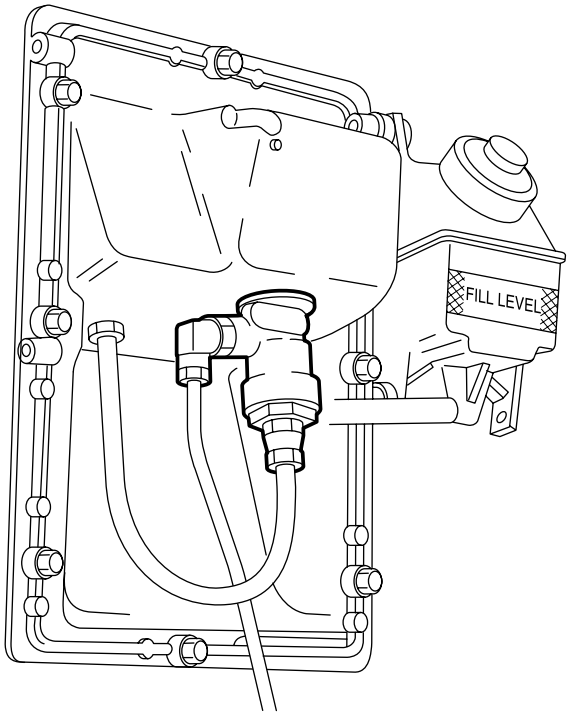
Operation of the range-change gear
Changing to the low or high speed range is done with a switch (B) on the front of the gear lever: turn the switch **down to select the low** range and **up** to select the **high** range. Pre-selection is permitted. Switching itself takes place when the gear lever passes neutral.

Operation of the splitter switch
Engaging half gears, or splitting, is done with the switch (A) on the side of the gear lever. Tip the **lower end** of the switch for **low** split selection and the **upper end** of the switch for **high** split selection.
When the switch has been operated, the clutch pedal must be **fully** depressed, after which the gear change is made.
Pre-selection is permitted.
When the splitter is in **low** split position, the splitter warning lamp “splitter low” on the instrument panel will illuminate.



D000096

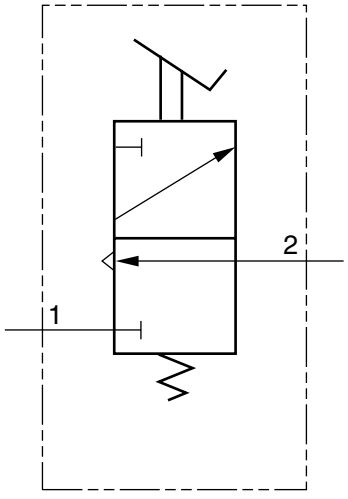
2.6 GV VALVE



V300177

Pneumatic symbol

Connection point	Function
1	Supply
2	Control pressure



V300164

Operation of GV valve
The GV (“Getriebevorschalt”) pre-selector valve ensures that when the clutch pedal is depressed pressure is supplied to the splitter cylinder via the relay valve.
If the clutch pedal is not depressed, this bleeds the splitter cylinder.
The splitter cylinder will stay in the position to which it was last switched.

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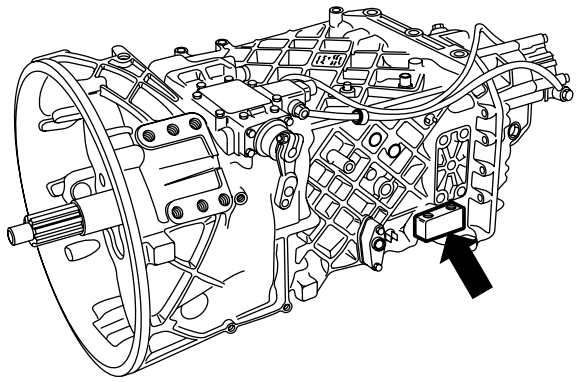
2.7 SPLITTER RELAY VALVE

In 16 S gearboxes, the splitter relay valve is located at the left-hand side of the gearbox. The valve is a 5/2 valve.
Depending on the type of gearbox (direct input or overdrive), two variants are possible.

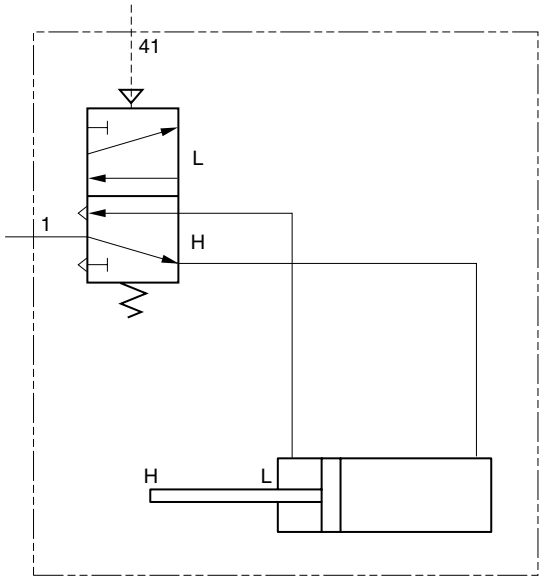


V300169

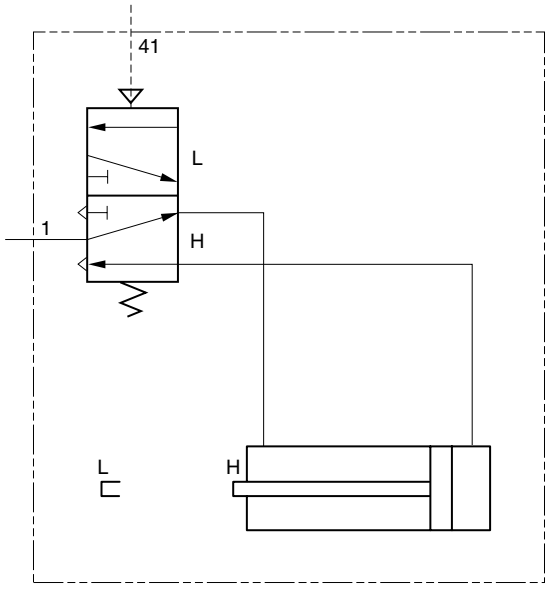
Pneumatic symbol
V300162 overdrive gearbox
V300163 direct input gearbox

Connection point	Function
1	Supply
41	Control pressure

Position	Function
L	Splitter high
H	Splitter low



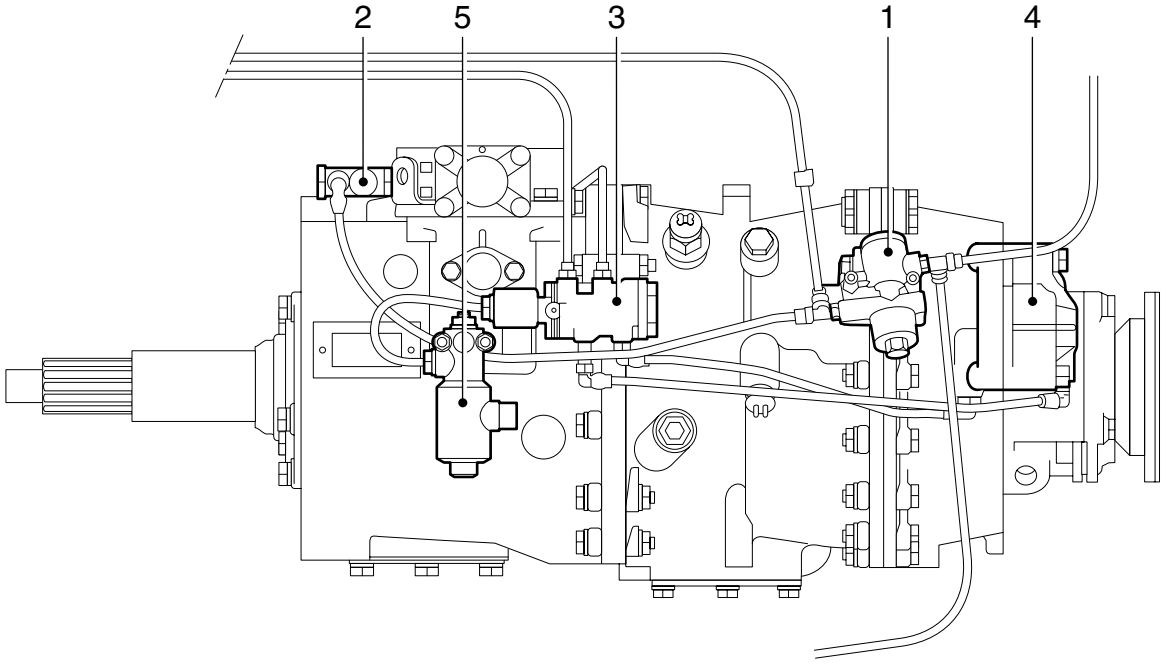
V300162



V300163

2.8 FILTER/GOVERNOR, EATON FS/6309A

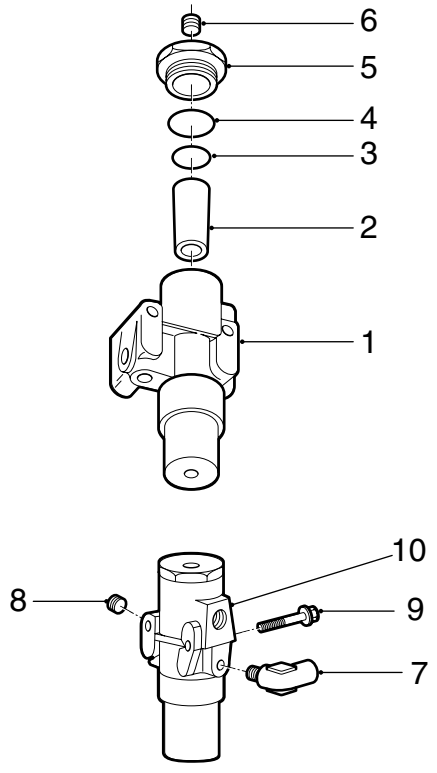
Filter/governor (1) on gearbox



V300558

Overview drawing, filter/governor, Eaton FS/6309A

1. Filter/governor housing
2. Filter element
3. Sealing ring
4. O-ring
5. Cover
6. Plug
7. Output
8. Selector valve output plug
9. Attachment bolt
10. Supply pressure input



V300430

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3. INSPECTION AND ADJUSTMENT

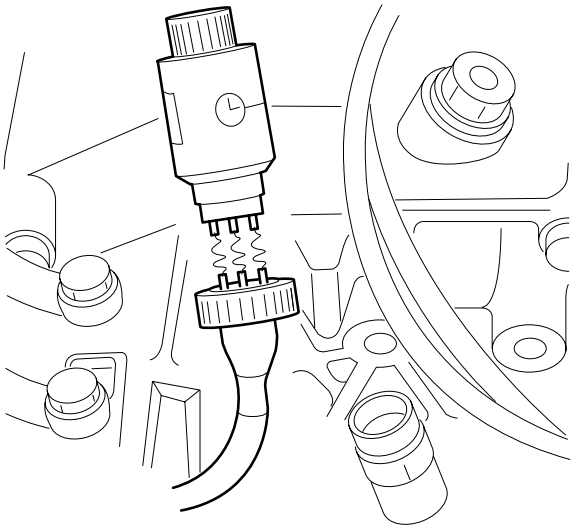
3.1 SIMULATION OF THE SPEED SIGNAL

The speed signal can be simulated using DELSI (DAF No. 0694941). DELSI must be connected to the speed sensor connector.

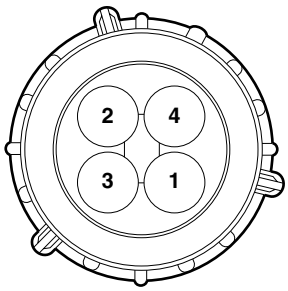
To connect DELSI to the speed sensor connector, an adapter cable needs to be made. The adapter cable must consist of the following wiring:

Pin 1: speed sensor, power supply
Pin 2: speed sensor, earth
Pin 3: speed sensor, real-time speed/distance signal
Pin 4: not in use

When the speed sensor connector is disconnected, a fault is stored in the tachograph. This error can be deleted using DAVIE XD.



V300425

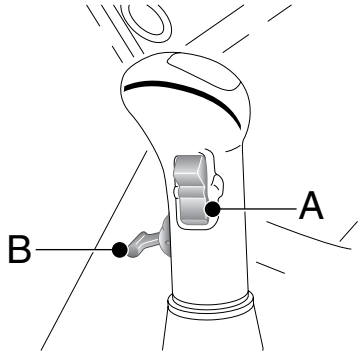


K100873

3.2 INSPECTION, DOWNSHIFT PROTECTION VALVE

Inspection without vehicle speed signal

1. Ensure there is sufficient air pressure.
2. Position the gear lever in neutral.
3. Switch the vehicle ignition on.
4. Use the range-change switch (**B**) on the gear lever to select the lower range. The range-change gear should now switch to the lower range.
5. Switch off the vehicle ignition. The range-change gear should now automatically switch to the higher range.

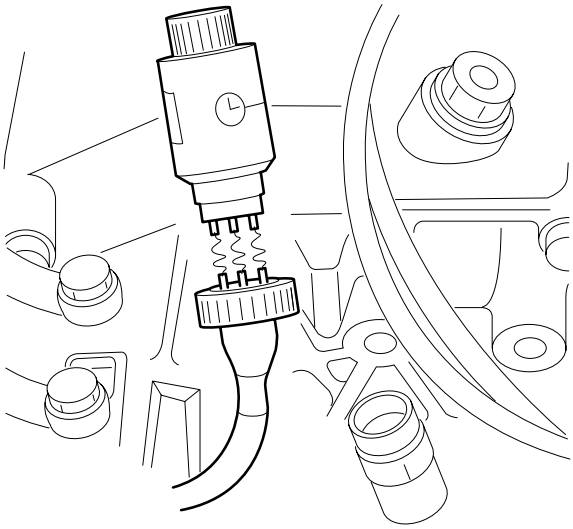


D000096

4

Inspection with the vehicle speed signal

1. Ensure there is sufficient air pressure.
2. Connect special tool Delsi-2 (DAF No. 0694941).


V300425

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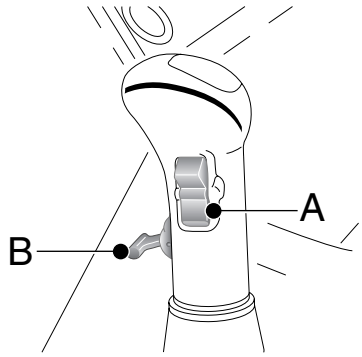
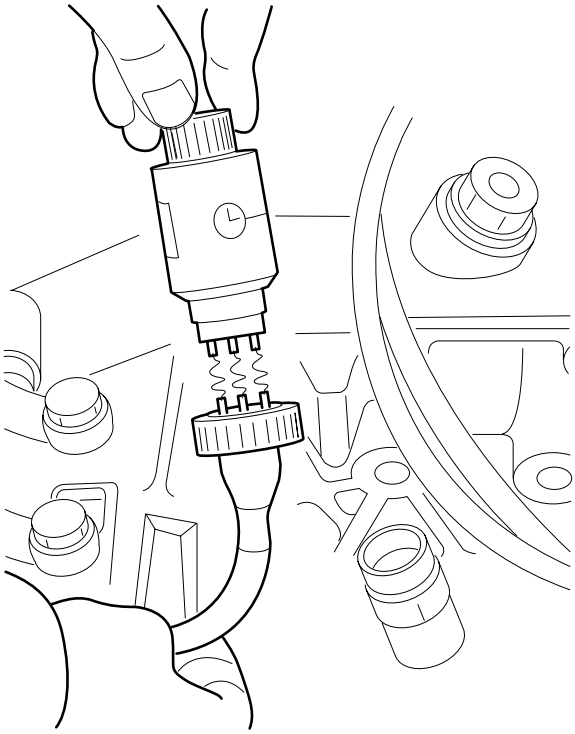
3. Position the gear lever in neutral.
4. Switch the vehicle ignition on.
5. Use the range-change switch (**B**) on the gear lever to select the lower range. The range-change gear should now switch to the lower range.



D000096

6. Use Delsi-2 to raise the simulated vehicle speed slowly to approximately 40 km/h. As the vehicle speed increases, the range-change gear should automatically switch to the higher range.
7. Use Delsi-2 to lower the simulated vehicle speed slowly to approximately 0 km/h. As the vehicle speed drops, the range-change gear should automatically switch to the lower range.

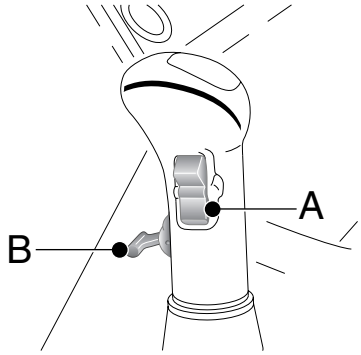

V300426

3.3 INSPECTION AND ADJUSTMENT, ZF/EATON GEARBOX GV VALVE

Inspection, ZF gearbox GV valve

1. Ensure that the gearbox is in neutral and the parking brake is engaged.
2. Start the engine and run it at idling speed.
3. Use the rocker switch (**A**) on the gear lever to select the other splitter mode **without** depressing the clutch pedal.
4. Carefully push the gear lever in the direction of reverse, until the teeth in the gearbox start to rattle.
5. Slowly depress the clutch pedal until the gear can be engaged in regular fashion (without rattling).

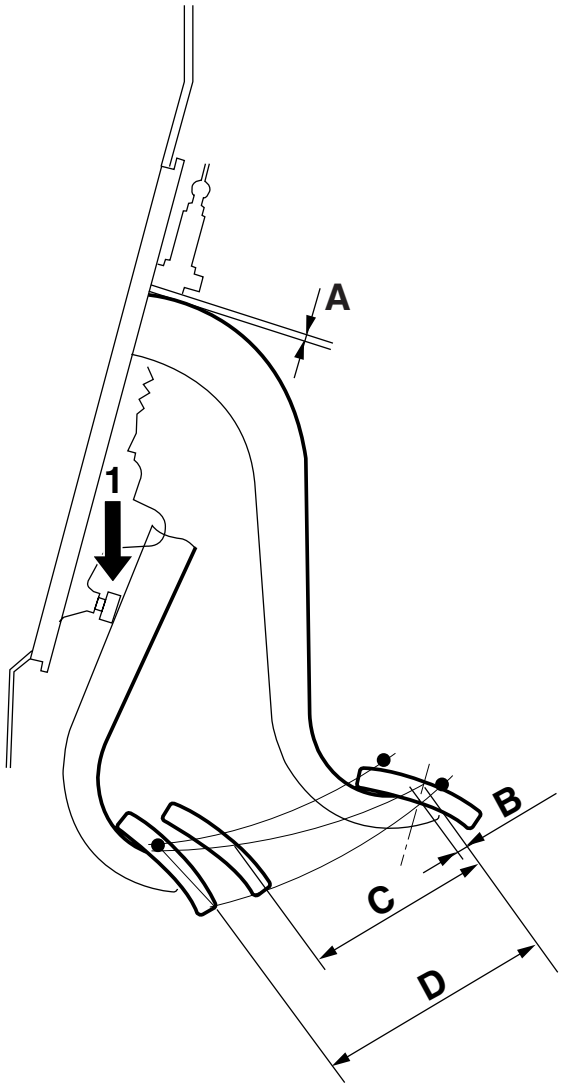
   Note:
   After the gear has been engaged or the rattling has stopped, the splitter must switch to the pre-selected mode (high or low, depending on the pre-selected position).



D000096

Inspection, Eaton gearbox GV valve

1. Ensure that the gearbox is in neutral and the parking brake is engaged.
2. Start the engine and run it at idling speed.
3. Carefully push the gear lever in the direction of reverse, until the teeth in the gearbox start to rattle.
4. Slowly depress the clutch pedal until the gear can be engaged in regular fashion (without rattling). This point must be the same as distance C. See “Technical data”.



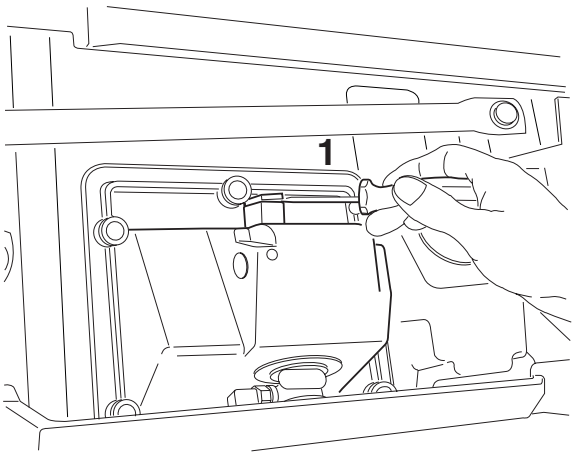
V300315

Adjusting ZF and/or Eaton gearbox GV valve

1. **Note:**

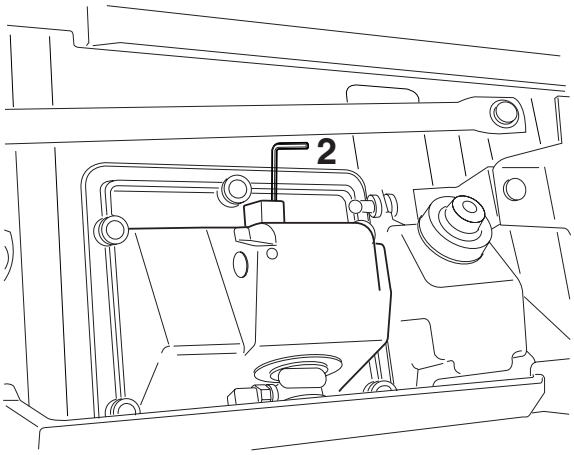
   In order to perform the various adjustments to the clutch pedal, the grille must first be opened.

   Remove the stop (1) from the clutch housing.



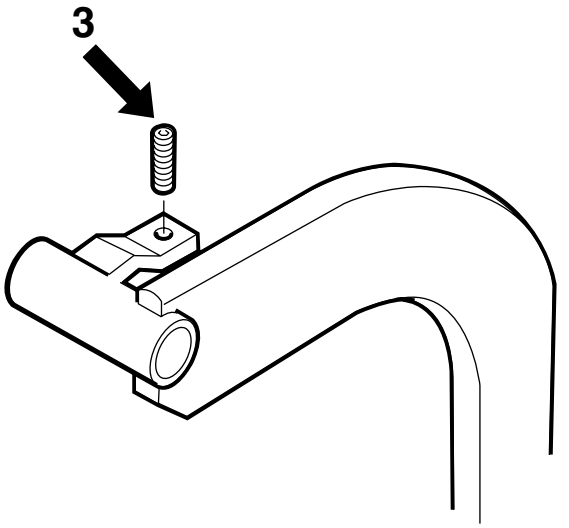
V300317

2. Fit an Allen key (2) at the place the stop comes out.



V300318

3. Using an Allen key (2) lowered into the opening of the stop, the adjusting screw (3) can be turned to correct the travel (C). See “Technical data”.
4. Fit the stop.



V300316

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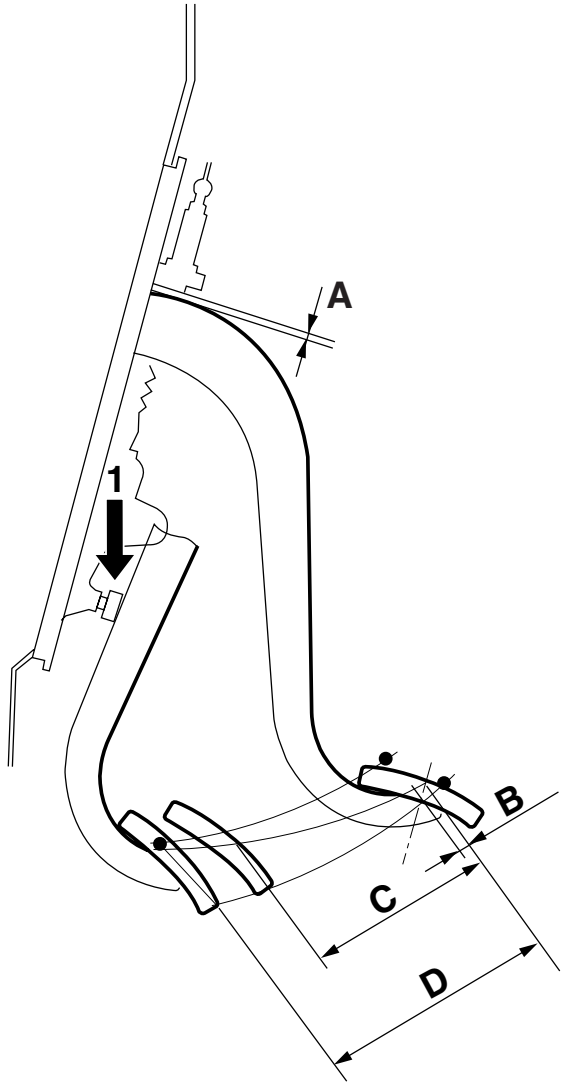
5. Adjust the travel (D) by means of the adjusting screw (1). See “Technical data”.
6. Check the operation of the GV valve.



V300315

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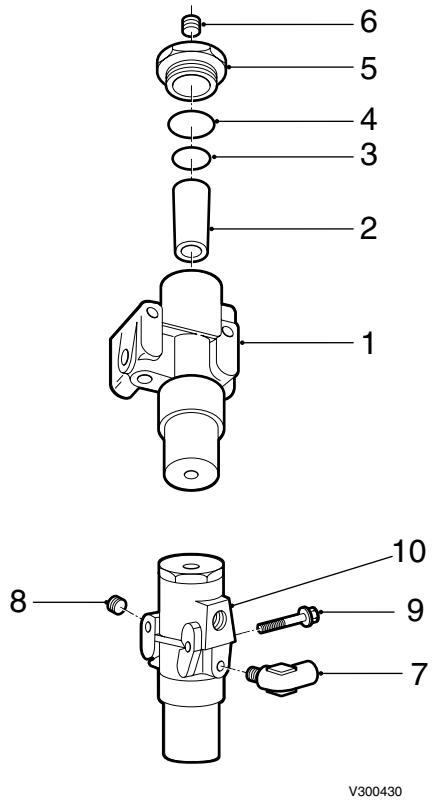
3.4 INSPECTION, FILTER/GOVERNOR, EATON FS/6309A

Inspection, filter/governor, Eaton FS/6309A

1. Remove plug (8) from the extra outlet and install a pressure gauge.
2. Check the service pressure. See “Technical data”.



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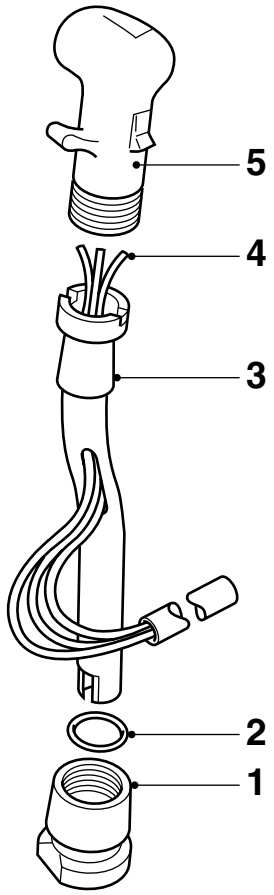
4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION, GEAR LEVER SELECTOR VALVE

Removing the gear lever selector valve

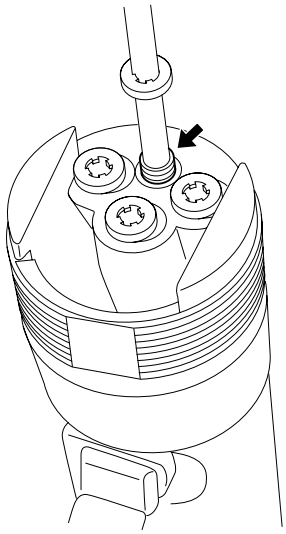
1. Disconnect the dust cover from the cab floor and raise it over the gear lever as high as possible.
2. Loosen the union nut (1) on the selector valve.
3. Raise the selector valve (5) slightly from the gear lever (3), far enough to enable the air pipes (4) to be disconnected.
4. Raise the coloured rings over the air pipes. These coloured rings also serve as markers.
5. Use a small screwdriver to depress the edge of the air connection, so that the pipes can be pulled from the switch.



V300143

Installing the gear lever selector valve

1. Connect the air pipes to the selector valve by pushing them into the respective connections as far as possible.
   For the connection points in the selector valve, see “Technical data”.
2. Slide the coloured rings back over the connection points.
3. Check whether the pneumatic system has an airtight connection and whether the range-change gear and the splitter can be operated.
4. Install the selector valve onto the gear lever and tighten the union nut.
5. Attach the gear lever dust cover to the cab floor.



V300159

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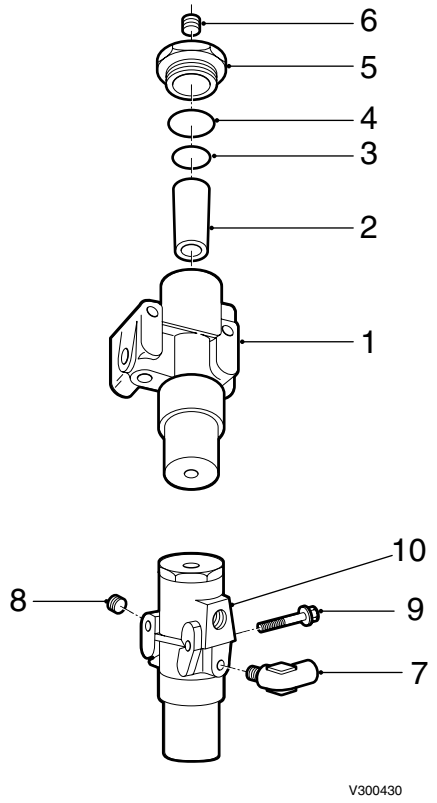
5. CLEANING

5.1 CLEANING FILTER/GOVERNOR, EATON FS/6309A

Cleaning filter/governor, Eaton FS/6309A

Note:
The filter must be regularly cleaned with water and a soap solution. Then blow clean the filter with compressed air from the inside.

1. Take the pressure off the air pressure system
2. Remove the plug (5).
3. Remove and wash the filter (2).
4. Clean the filter housing and if necessary remove the valve.
5. Replace the sealing ring (3) and O-ring (4).
6. Reassemble and reinstall the filter/governor.



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CONTENTS

		Page	Date
1.	**GENERAL**	1-1	0111
1.1	System description, ZF 6S-850 gearbox	1-1	0111
2.	**COMPONENT DESCRIPTION**	2-1	0111
2.1	Synchroniser	2-1	0111
3.	**INSPECTION AND ADJUSTMENT**	3-1	0111
3.1	Inspection, gearbox oil level	3-1	0111
3.2	Inspection and adjustment, input shaft bearing axial clearance	3-2	0111
3.3	Inspection and adjustment, secondary shaft axial play	3-3	0111
4.	**REMOVAL AND INSTALLATION, GEARBOX**	4-1	0111
4.1	Removal and installation , entire gearbox	4-1	0111
4.2	Removal and installation, drive flange	4-3	0111
4.3	Removal and installation, output shaft oil seal	4-4	0111
4.4	Removal and installation, gearbox front cover sealing ring	4-5	0111
4.5	Removal and installation, selector shaft oil seal	4-6	0111
5.	**DRAINING AND FILLING**	5-1	0111
5.1	Draining and filling, gearbox	5-1	0111

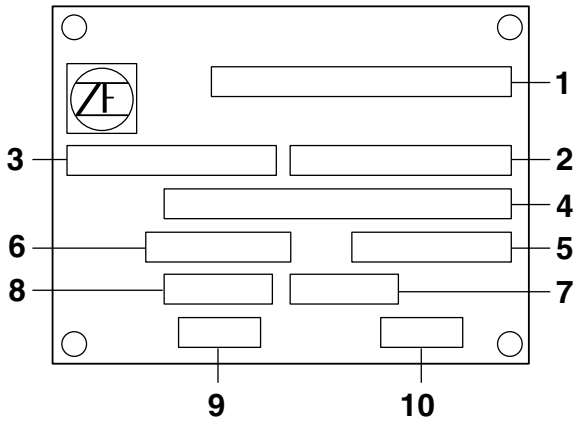
5

5

1. GENERAL

Gearbox type
Each gearbox has a type plate attached to it, indicating the type of gearbox. This data can also be found on the identity card for the vehicle concerned.

ZF gearbox type-plate
1. Type of gearbox
2. Serial no. (ZF)
3. Parts list (ZF)
4. Specification no.
5. Pulse generator ratio
6. Gearbox ratio
7. Engine speed using PTO
8. PTO speed
9. Gearbox oil capacity
10. Oil specification



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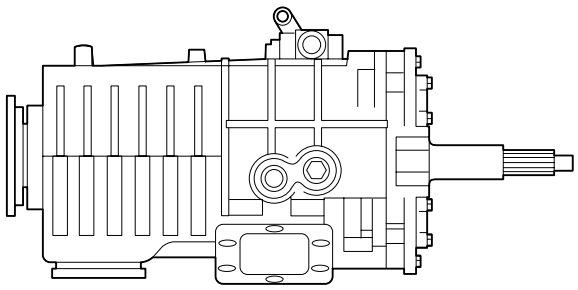
1.1 SYSTEM DESCRIPTION, ZF 6S-850 GEARBOX

The gearbox consists of six synchronised forward gears, and one non-synchronised reverse gear.


V300466

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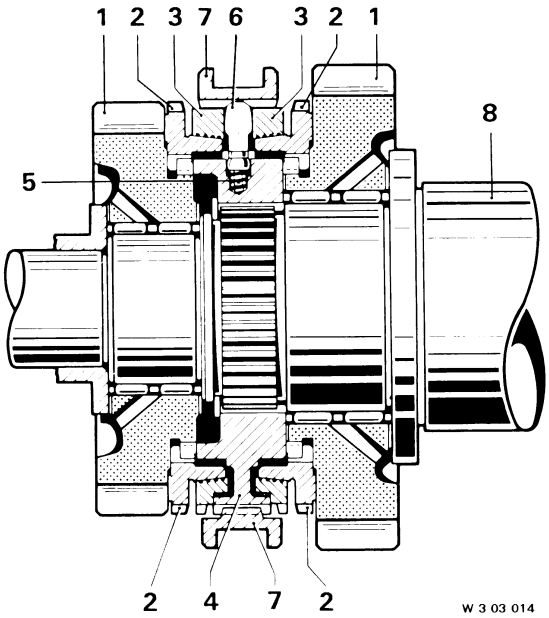
2. COMPONENT DESCRIPTION

2.1 SYNCHRONISER

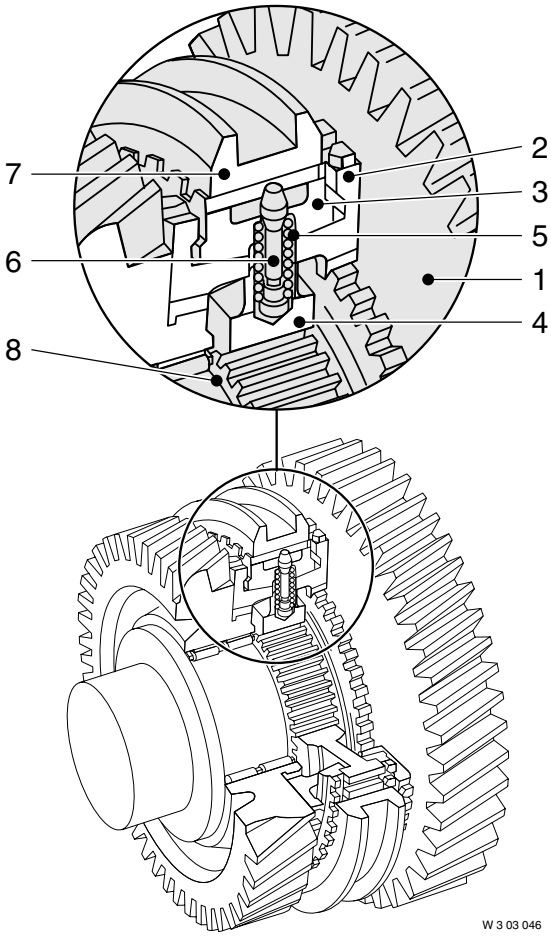
B-lock synchronisation
The synchroniser consists of the following parts:

1. Gear
2. Clutch body
3. Synchromesh ring
4. Synchroniser sleeve support
5. Pressure spring
6. Thrust piece
7. Synchroniser sleeve
8. Main shaft

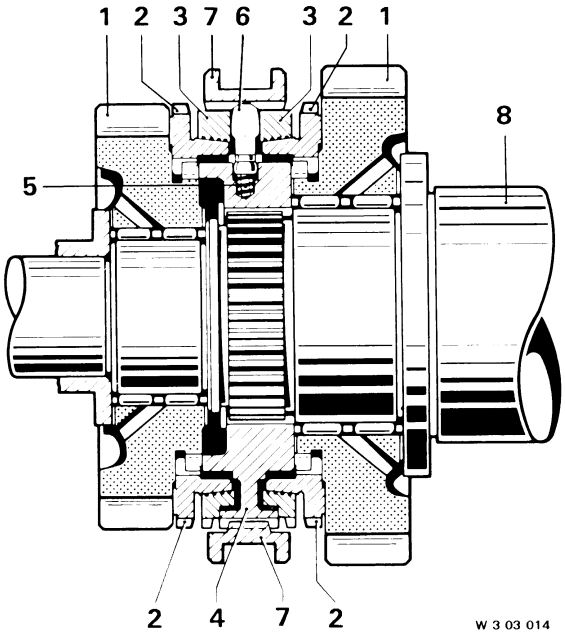


In neutral, the synchroniser sleeve (7) is in the centre position.
Pressure springs (5) push the thrust pieces (6) into a wedge-shaped recess in the synchroniser sleeve (7).
The gear wheels (1) and corresponding clutch bodies (2) move freely around the main shaft (8).

If the synchroniser sleeve (7) is shifted to the right from the neutral position, the synchromesh ring (3) is pushed against the friction cone of the clutch body (2) by the thrust pieces (6).
The difference in speed immediately turns the synchromesh ring (3) to a stop on the synchroniser sleeve support (4), which is not in the figure, and thus prevents further movement of the synchroniser sleeve (7).



As a result of continued pressure on the synchroniser sleeve (7) (friction), the speed of the gear (1) to be shifted with the clutch body (2) matches the speed of the main shaft (8).
The bevelled sides of the teeth on the synchromesh ring (3) and the synchroniser sleeve (7) cause the synchromesh ring (3) to be turned back slightly after synchronisation.
This releases the lock and allows the synchroniser sleeve (7) to be moved into the teeth of the clutch body (2).
Hence the relevant gear is engaged.



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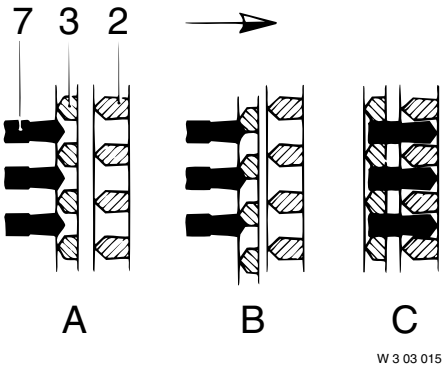
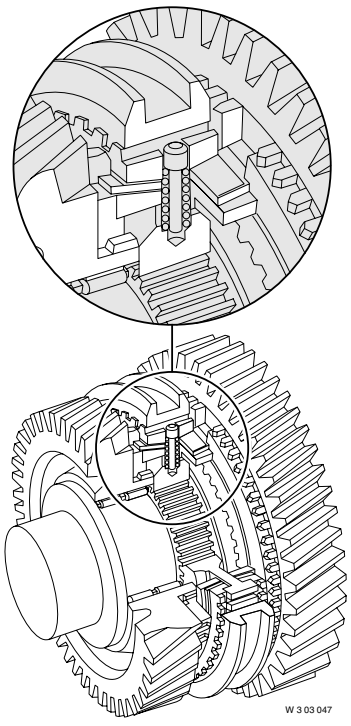
A. Not engaged
B. Synchronise
C. Engaged



Double-cone synchronisation
As a result of the speed difference to be eliminated in the lower gears, the synchronisation forces may be considerable. In order to achieve effective synchronisation, a synchroniser with a double cone is used.
This synchroniser consists of an outer and an inner ring (synchromesh rings) connected to the main shaft of the gearbox by means of the selector sleeve support.
The ring between the two synchromesh rings is connected to the gear wheel by means of the clutch body.
When the selector sleeve moves into the clutch body, two synchronisation surfaces are active.



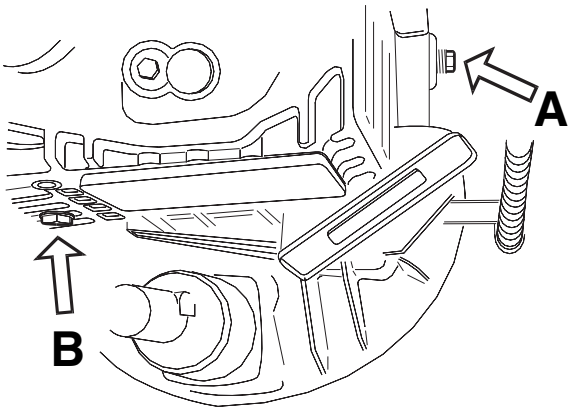
3. INSPECTION AND ADJUSTMENT

3.1 INSPECTION, GEARBOX OIL LEVEL

To prevent skin injury, avoid unnecessary contact with the drained oil.

ZF 6S-850 gearbox

1. Position the vehicle on a level surface.
2. Wait for some minutes for the oil to flow back.
3. Remove the level check plug and check the oil level.
4. The oil level must reach the rim of the level check/filler opening (A).
5. After checking the oil level, tighten the level check plug to the specified torque. See “Technical data”.



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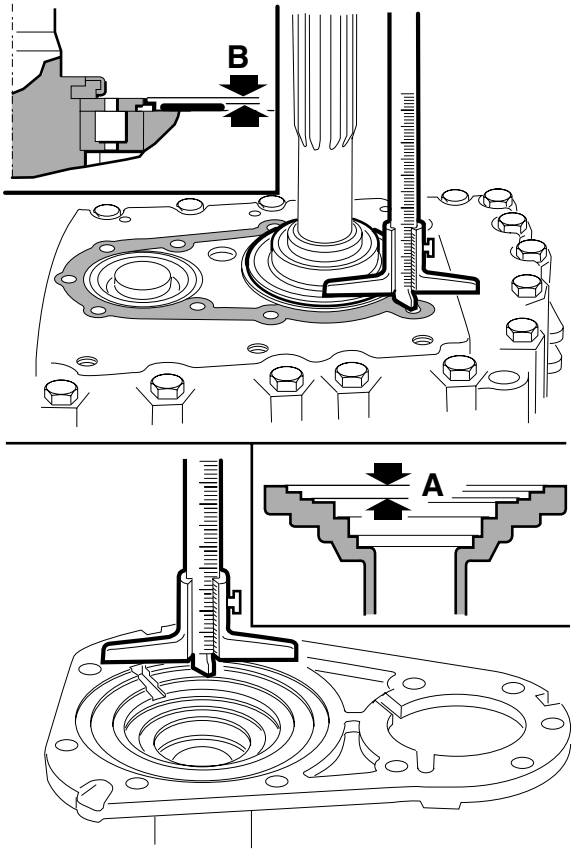
3.2 INSPECTION AND ADJUSTMENT, INPUT SHAFT BEARING AXIAL CLEARANCE

ZF 6S-850 gearbox

1. Remove the gearbox. See “Removal and installation”.
2. Remove the gearbox front cover from the input shaft. See “Removal and installation”.
3. Press the outermost bearing race uniformly so that the bearing is free of play. Constantly rotate the input shaft while applying pressure so that the bearing is set.
4. Use a depth gauge to determine the depth of the chamber in the gearbox front cover, distance A.
5. Install a new gasket in the gearbox housing. Use a depth gauge to determine the height the ball bearing protrudes above the gearbox housing, distance B.
6. Calculate the play as follows. See the table below.

Distance A	8.05 mm
Distance B	– 7.90 mm
Play	0.15 mm

7. Compare the calculated value with the maximum allowable axial play. See “Technical data”.
8. If necessary, adjust the axial play by means of another adjusting ring.
9. Fit a new gasket to the gearbox front cover and fit the gearbox front cover to the gearbox. See “Removal and installation”.
10. Fit the attachment bolts. Tighten the attachment bolts to the specified torque. See “Technical data”.
11. Fit the gearbox. See “Removal and installation”.



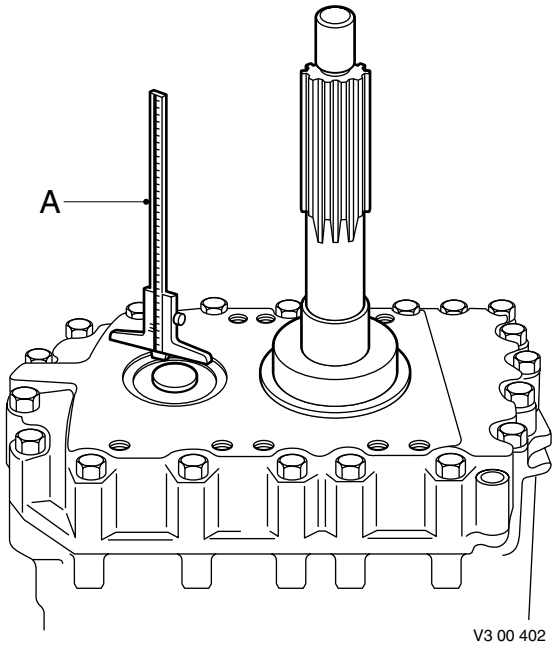
V3 00 435

3.3 INSPECTION AND ADJUSTMENT, SECONDARY SHAFT AXIAL PLAY

Inspection and adjustment, secondary shaft axial play

1. Press the outermost bearing race uniformly so that the bearing is free of play. Rotate the secondary shaft constantly while pressing, so that the bearing gets set.
2. Use a depth gauge to determine the distance between the outer bearing race and the gearbox housing (A).
3. Compare the measured value with the specified permissible value. See “Technical data”.
4. If necessary, adjust the axial play by means of another adjusting ring.
5. Calculate the play for the correct size of the adjusting ring as follows:

Distance A		2.95 mm
Gasket thickness		+ 0.40 mm
Play (0 - 0.1)		- 0.05 mm
Required adjusting ring =	3.30	± 0.05 mm



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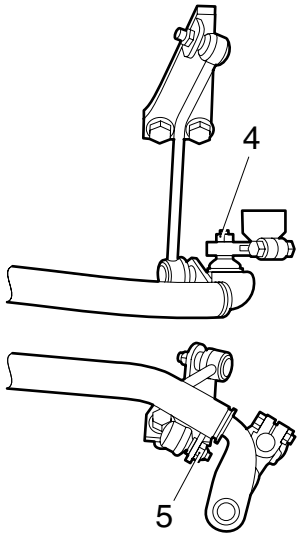
4. REMOVAL AND INSTALLATION, GEARBOX

4.1 REMOVAL AND INSTALLATION , ENTIRE GEARBOX

Removing the entire gearbox

1. Make sure there are no loose items in the cab. Tilt the cab.
2. Disconnect the negative terminal of the battery.
3. Remove the gearbox cable harness and secure it.
4. Loosen the tachometer connection.
5. Remove the shift control by loosening the torque rod bracket and the lever on the selector shaft.
6. Remove the prop shaft and secure it so that it does not form a hindrance in further operations.
7. Remove the exhaust pipe between the engine brake and the silencer.
8. Remove the clutch servo. No air or hydraulic pipes need be removed. Secure the servo and ensure that no one in the cab can operate the clutch pedal as long as the servo is not fitted.
9. Place a jack under the gearbox and remove the bolts around the clutch housing.
10. Use the jack to pull the gearbox from the engine and remove the gearbox.



V300407

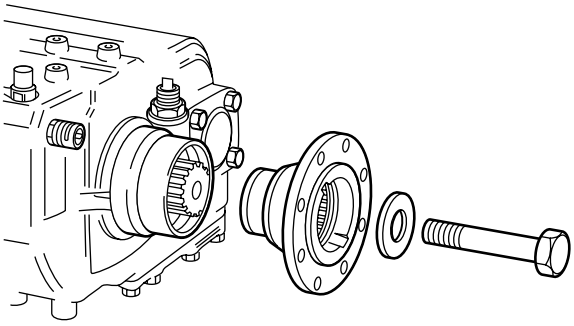
Installing the entire gearbox

1. Before positioning the gearbox, one gear should be engaged in order to allow the input shaft to slide into the clutch plate during installation. Also, grease the input shaft sparingly with the specified grease.
2. Fit the thrust bearing.
3. Use the jack to move the gearbox towards the engine and install the attachment bolts around the gearbox.
4. Install the clutch servo and tighten the attachment bolts.
5. Fit the exhaust pipe between the engine brake and the silencer.
6. Fit the drive flange.
7. Fit the shift control.
8. Fit the cable harness and tachometer connection.
9. Connect the negative terminal of the battery.
10. Inspect the shift control.
11. Check the oil level after the gearbox has been installed.
12. If a gearbox of a different type is mounted, or a gearbox with a different reduction, this should be reported. If the correct data are present, they can be input into the VIC using DAVIE XD.

4.2 REMOVAL AND INSTALLATION, DRIVE FLANGE

Removing the drive flange

1. Make a reference mark on the prop shaft and flange.
2. Detach the prop shaft from the flange and secure it.
3. Fit special tool (DAF No. 0484977) to hold the drive flange in position.
4. Remove the attachment bolt and washer.
5. Remove the drive flange from the shaft using special tool (DAF No. 0484978).



V3 00 416

Installing the drive flange

1. Heat the drive flange to a temperature of max. 120°C.
2. Oil the output shaft lightly and slide the drive flange over the shaft in its correct position.
3. Fit special tool (DAF No. 0484977) to the drive flange.
4. Tighten the attachment bolt to the specified torque. See “Technical data”.
5. Attach the prop shaft.

5

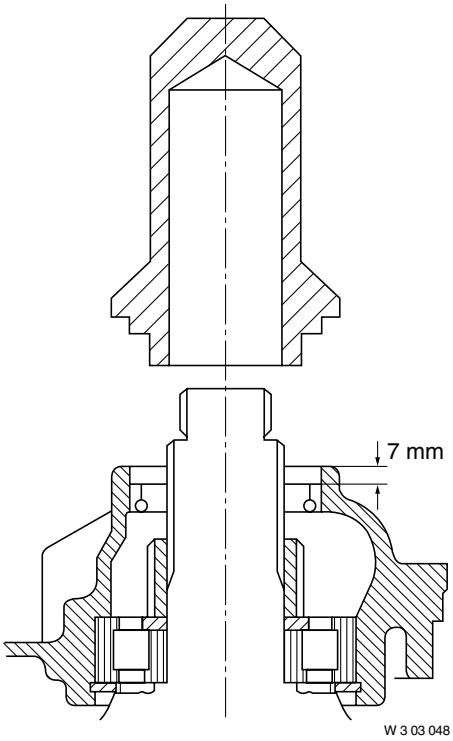
4.3 REMOVAL AND INSTALLATION, OUTPUT SHAFT OIL SEAL

Removing the output shaft oil seal

1. Remove the drive flange.
2. Pull the oil seal from the gearbox housing using the special tool (DAF No. 0484899).

Installing the output shaft oil seal

1. Around the oil seal, clean the gearbox housing without letting dirt into the gearbox.
2. Voorzie keerringen met een staalmantel aan de buitenzijde spaarzaam van vloeibare pakking.
   Voorzie keerringen met een rubbermantel aan de buitenzijde spaarzaam van groene zeep.
3. Fit the oil seal in the gearbox housing using the special tool (DAF No. 0694816). The tool will position the oil seal at the correct depth in the housing.
4. Fit the drive flange.



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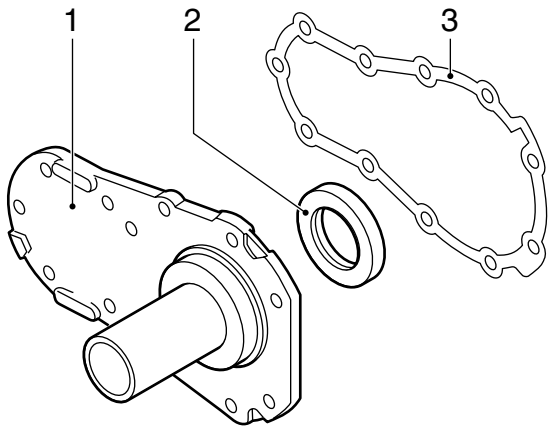
4.4 REMOVAL AND INSTALLATION, GEARBOX FRONT COVER SEALING RING

Removing the gearbox front cover oil seal

1. Remove the gearbox.
2. Remove the release mechanism assembly with fork and thrust bearing.
3. Remove the attachment bolts from the gearbox front cover (1). Remove the gearbox front cover from the input shaft. Keep the filler plates of the input shaft and the secondary shaft.
4. Remove the oil seal (2) from the gearbox front cover.



V3 00 401

Installing the gearbox front cover oil seal

1. Apply small amount of sealant to the oil seals fitted with a steel sleeve on the outside. Apply a rubber coating to the oil seals' exterior and apply green soap sparingly.
2. Fit the oil seal (2) to the gearbox front cover using special tools (DAF Nos. 0499809 and 0484924). Fit a new gasket (3).
3. Check the input shaft axial play. See "Inspection and adjustment".
4. Install the gearbox front cover (1). Tighten the attachment bolts to the specified torque. See "Technical data".
5. Install the release mechanism on the gearbox. Tighten the attachment bolts to the specified torque. See "Technical data".
6. Fit the gearbox.

5

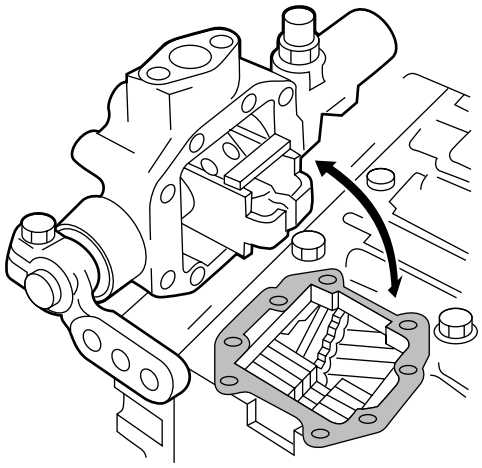
4.5 REMOVAL AND INSTALLATION, SELECTOR SHAFT OIL SEAL

LHD version

Removing the selector shaft oil seal

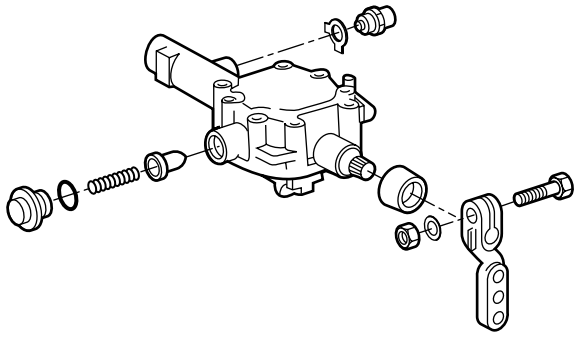
1. Mark the gearbox lever relative to the selector shaft and remove the control lever with the gearbox control. If necessary, disconnect the torque rod.
2. Remove the selector shaft housing attachment bolts and remove the complete selector shaft housing from the gearbox.

Seal the gearbox opening, so that no dirt can enter.



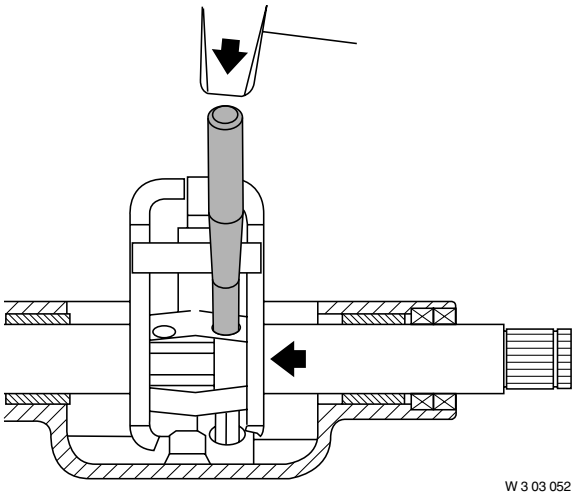
V3 00 398

3. Remove the locking pin and control stop from the selector shaft housing.



V3 00 399

4. Drive two spring pins from the selector fingers. Turn the selector fingers so that the spring pins can be driven into a slot in the cover.
5. Remove the circlip and the springs from the rear of the cover. Then remove the selector fingers from the cover.



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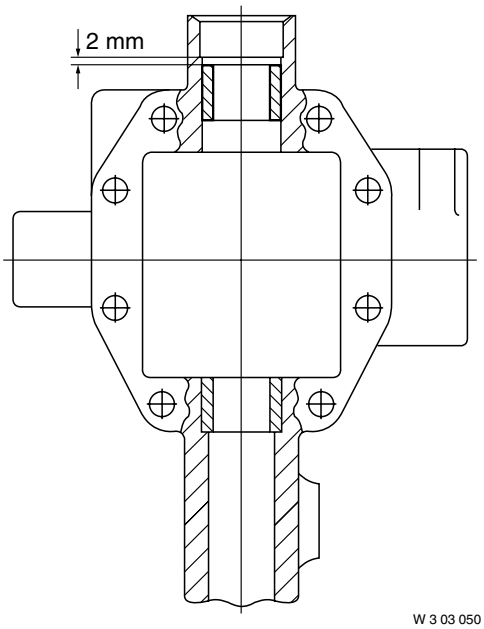
6. Drive the oil seal and dust seal out of the selector shaft housing. If necessary, the selector shaft bearing bushes now can be replaced with special tool (DAF No. 0694818). Press the bearing bush on the control side 2 mm under the edge.



LHD version

Installing the selector shaft oil seal

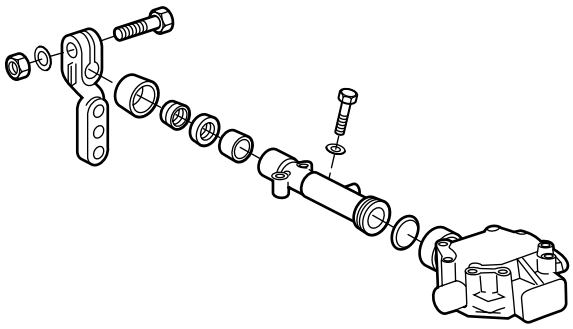
1. Sparingly apply a liquid gasket to the oil seal and fit it in the control cover using special tool (DAF No. 0535659). Now fit the dust seal in the control cover using special tool (DAF No. 0535659). Apply grease to the oil seal lips.
2. Fit special tool (DAF No. 0694817), a guide sleeve, over the selector shaft and fit the selector fingers and the gear lever lock into the selector housing. Fit the selector shaft. Watch the control bolt slot.
3. First fit the control stop, before fitting the spring pins.
4. Fit the spring pins and the locking pin.
5. Apply sealant to the sealing cap. Install the springs, rings, and the sealing cap. Fit the circlip.
6. Put the gearbox into neutral and install a new gasket in the selector shaft housing and fit it to the gearbox housing. Tighten the attachment bolts to the specified torque. See “Technical data”.
7. Fit the shift control and check that all switches function properly.

5

RHD version

Removing the selector shaft oil seal

1. Mark the gearbox lever relative to the selector shaft and remove the control lever with the gearbox control. If necessary, disconnect the torque rod.
2. Remove the bearing housing attachment bolts and slide it off the selector shaft.
3. Drive the dust and oil seals out of the bearing housing. If necessary, the selector shaft bearing bushes now can be replaced with special tool (DAF No. 0694818). Press the bearing bush on the spring side 2 mm under the edge.



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Installing the selector shaft oil seal

1. Sparingly apply a liquid gasket to the oil seal and fit it in the bearing housing using special tool (DAF No. 0535659). Now fit the dust seal in the bearing housing using special tool (DAF No. 0535659).
2. Apply grease to the oil seal lips. Fit a new O-ring to the selector shaft housing. Fit the selector shaft housing over the selector shaft.
3. Tighten the attachment bolts to the specified torque and install the gearbox control. Tighten the attachment bolts to the specified torque. See “Technical data”. Check that all switches function properly.

5

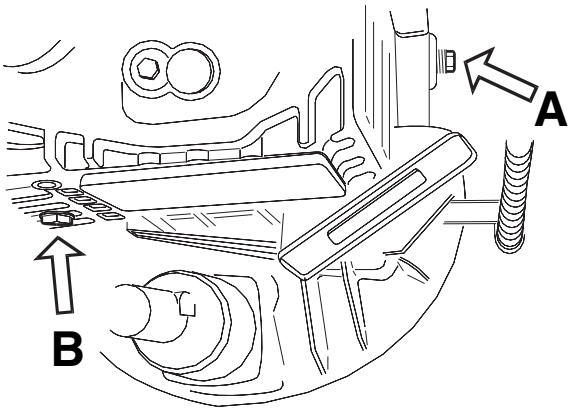
5. DRAINING AND FILLING

5.1 DRAINING AND FILLING, GEARBOX

To prevent skin injury, avoid unnecessary contact with the drained oil.

Draining, gearbox
1. Place the vehicle on a level surface.
2. Drain the gearbox at operating temperature using plug (B).

Filling, gearbox
1. Clean the drain plug and fit it, tightening to the specified torque. See “Technical data”.
2. Top up oil through the level check/filler opening (A) until the oil reaches the rim of the filling opening.
3. After filling the gearbox, tighten the level check plug to the specified tightening torque. See “Technical data”.



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CONTENTS

		Page	Date
1.	**GENERAL**	1-1	0111
1.1	System description, 16S gearboxes	1-2	0111
2.	**COMPONENT DESCRIPTION**	2-1	0111
2.1	Synchroniser	2-1	0111
3.	**INSPECTION AND ADJUSTMENT**	3-1	0111
3.1	Inspection, gearbox oil level	3-1	0111
3.2	Inspection and adjustment, input shaft bearing axial clearance	3-2	0111
3.3	Inspection and adjustment, gearbox output shaft bearing axial clearance	3-4	0111
3.4	Inspection and adjustment, selector shaft housing on gearbox	3-5	0111
4.	**REMOVAL AND INSTALLATION, GEARBOX**	4-1	0111
4.1	Removal and installation , entire gearbox	4-1	0111
4.2	Removal and installation, drive flange	4-3	0111
4.3	Removal and installation, output shaft oil seal	4-5	0111
4.4	Removal and installation, gearbox front cover sealing ring	4-6	0111
4.5	Removal and installation, selector shaft oil seal	4-7	0111
5.	**DRAINING AND FILLING**	5-1	0111
5.1	Draining and filling, gearbox	5-1	0111
5.2	Gearbox ZF 8/9/16S-109 with integrated retarder	5-2	0111

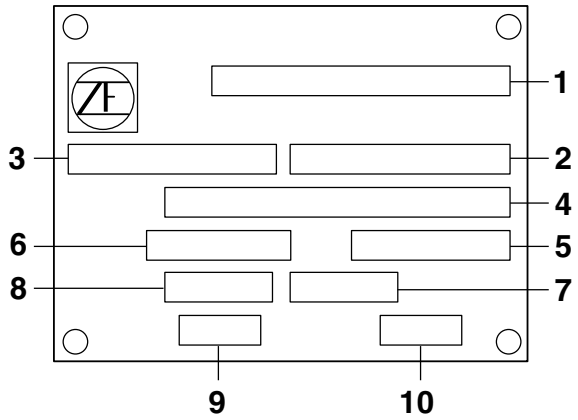
6

6

1. GENERAL

Gearbox type
Each gearbox has a type plate attached to it, indicating the type of gearbox. This data can also be found on the identity card for the vehicle concerned.

ZF gearbox type-plate
1. Type of gearbox
2. Serial no. (ZF)
3. Parts list (ZF)
4. Specification no.
5. Pulse generator ratio
6. Gearbox ratio
7. Engine speed using PTO
8. PTO speed
9. Gearbox oil capacity
10. Oil specification



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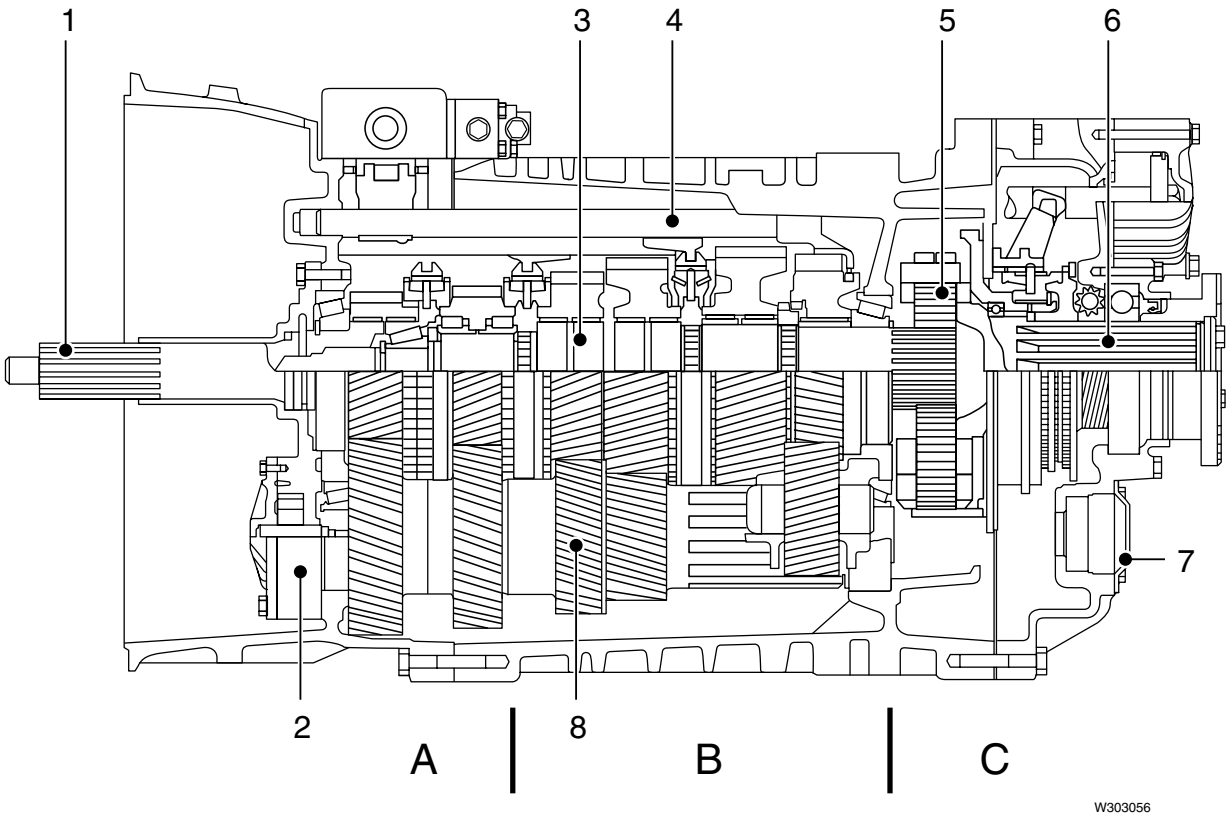
1.1 SYSTEM DESCRIPTION, 16S GEARBOXES



A. Integrated auxiliary gearbox or splitter gearbox (two gears)
B. Main gearbox with four forward gears and one reverse gear
C. Auxiliary gearbox or range gearbox (two gears)

1. Input shaft
2. Lubricating oil pump
3. Main shaft
4. Selector shafts with shifting forks
5. Planetary gears for range group
6. Output shaft
7. PTO connection point
8. Auxiliary shaft

Example of type designation 16 S 109

16	=	16 gears
S	=	all forward gears synchronised
109	=	mark for the input engine torque

A. Integrated auxiliary gearbox
This is an auxiliary gearbox located in the main gearbox housing. Using an additional set of gears, the auxiliary shaft of the main gearbox can be driven by two different ratios. In this way, each gear in the main box can be engaged in a low or high ratio, or split into two (also known as “splitting”). Hence, the number of gears of the main gearbox is doubled.

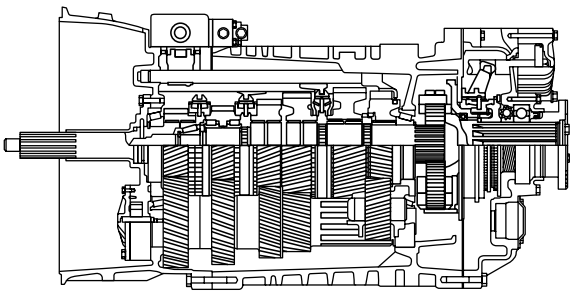
B. Main gearbox
The main gearbox consists of four synchronised forward gears, and one non-synchronised reverse gear.

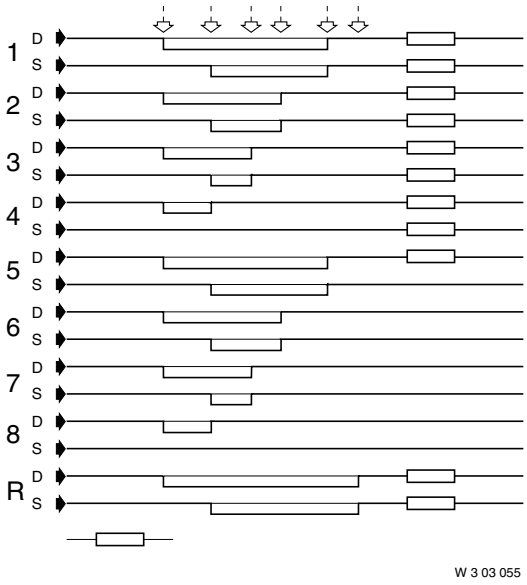
C. Planetary auxiliary gear
This is a gearbox mounted onto the rear of the main gearbox, consisting of one planetary gear wheel set.

Using this set of gears, all gears of the main gearbox can be used once with the auxiliary gearbox in a low ratio, and once with the auxiliary gearbox in a 1:1 ratio.
Hence, the number of gears of the main gearbox is doubled.

In popular terms, the number of gears in the gearbox is “stacked”. This is why the term “stacking box” or range box arose.

16S109
By means of the splitter gearbox, the four gears in the main gearbox are multiplied by two, while the use of the auxiliary gearbox multiplies this figure by two again, which results in 4x2x2 = 16 forward gears.





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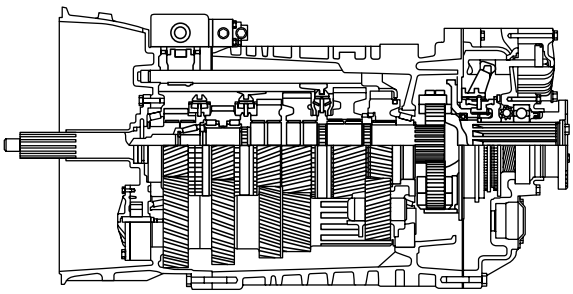
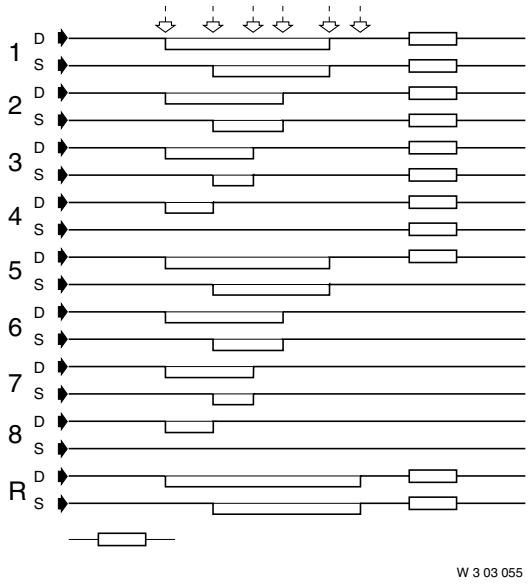
8/9S 109
The four gears in the main gearbox are doubled when the auxiliary gearbox is used, giving 4 x 2 = 8 or, with the crawler gear as well, 9 forward gears.
The diagram shows the power distribution across the individual gear pairs for each gear.

Direct input shaft version of the ZF 16S-109
D = splitter “Direct”
S = splitter “Fast”





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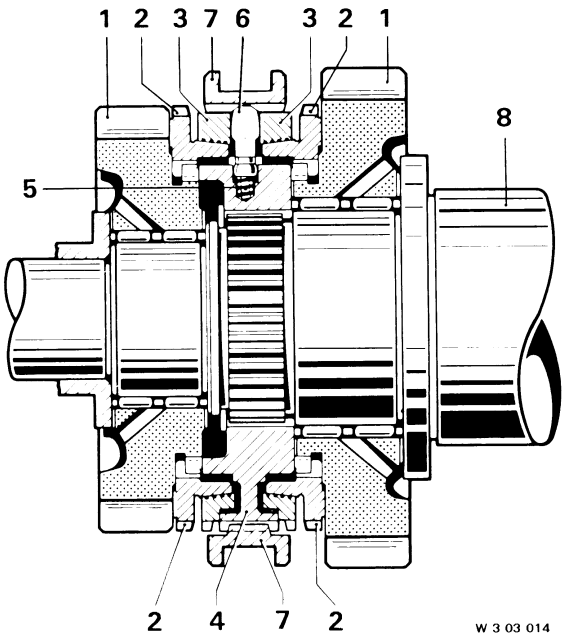
2. COMPONENT DESCRIPTION

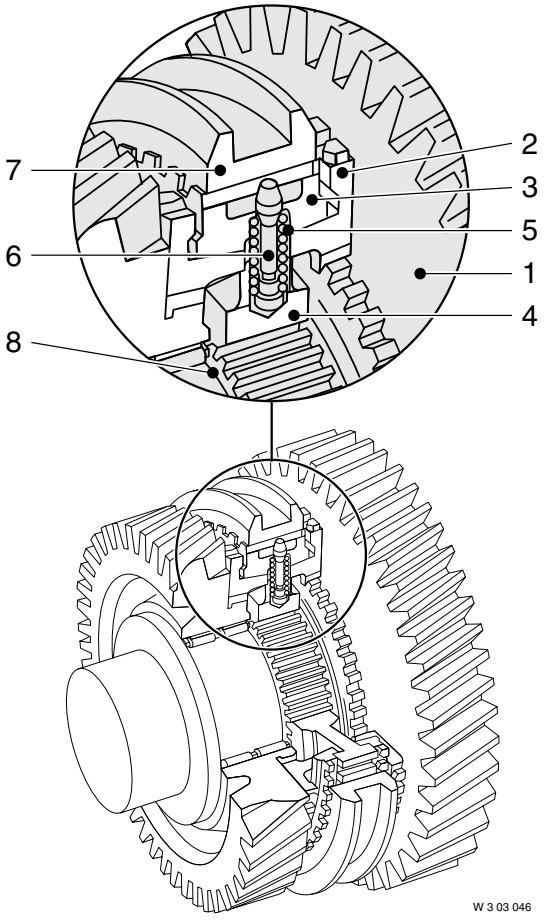
2.1 SYNCHRONISER

B-lock synchronisation
The synchroniser consists of the following parts:

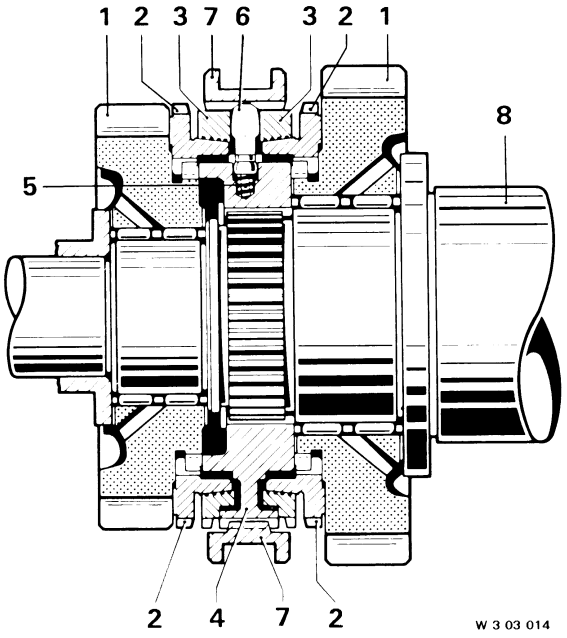
1. Gear
2. Clutch body
3. Synchromesh ring
4. Synchroniser sleeve support
5. Pressure spring
6. Thrust piece
7. Synchroniser sleeve
8. Main shaft



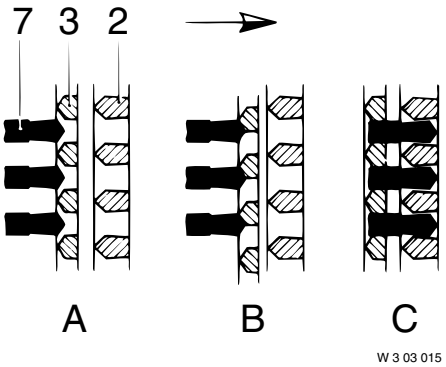
In neutral, the synchroniser sleeve (7) is in the centre position.
Pressure springs (5) push the thrust pieces (6) into a wedge-shaped recess in the synchroniser sleeve (7).
The gear wheels (1) and corresponding clutch bodies (2) move freely around the main shaft (8).
If the synchroniser sleeve (7) is shifted to the right from the neutral position, the synchromesh ring (3) is pushed against the friction cone of the clutch body (2) by the thrust pieces (6).
The difference in speed immediately turns the synchromesh ring (3) to a stop on the synchroniser sleeve support (4), which is not in the figure, and thus prevents further movement of the synchroniser sleeve (7).



As a result of continued pressure on the synchroniser sleeve (7) (friction), the speed of the gear (1) to be shifted with the clutch body (2) matches the speed of the main shaft (8).
The bevelled sides of the teeth on the synchromesh ring (3) and the synchroniser sleeve (7) cause the synchromesh ring (3) to be turned back slightly after synchronisation.
This releases the lock and allows the synchroniser sleeve (7) to be moved into the teeth of the clutch body (2).
Hence the relevant gear is engaged.



A. Not connected
B. Synchronising
C. Connected



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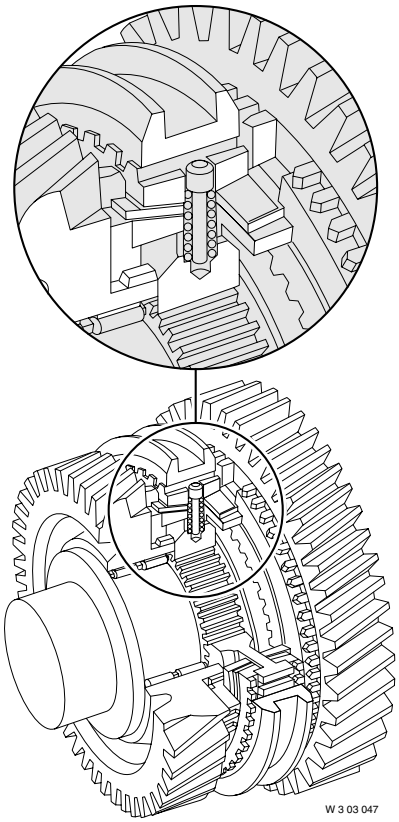
Double-cone synchronisation
As a result of the speed difference to be eliminated in the lower gears, the synchronisation forces may be considerable. In order to achieve effective synchronisation, a synchroniser with a double cone is used.
This synchroniser consists of an outer and an inner ring (synchromesh rings) connected to the main shaft of the gearbox by means of the selector sleeve support.
The ring between the two synchromesh rings is connected to the gear wheel by means of the clutch body.
When the selector sleeve moves into the clutch body, two synchronisation surfaces are active.



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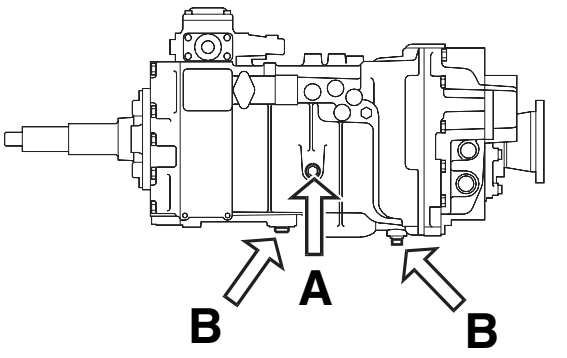
3. INSPECTION AND ADJUSTMENT

3.1 INSPECTION, GEARBOX OIL LEVEL

To prevent skin injury, avoid unnecessary contact with the drained oil.

ZF 8S/9S-109 gearboxes

1. Position the vehicle on a level surface.
2. Wait for some minutes for the oil to flow back.
3. Remove the level check plug and check the oil level.
4. The oil level must reach the rim of the level check/filler opening (A).
5. After checking the oil level, tighten the level check plug to the specified torque. See “Technical data”.



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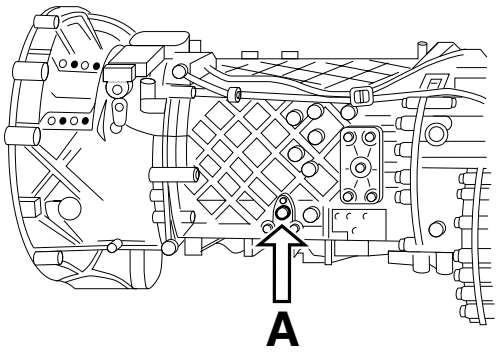
ZF 8S/9S-109 with integrated retarder

1. Place the vehicle on a level surface. Apply the brakes without activating the retarder.
2. Wait for some minutes for the oil to flow back.
3. Remove the level check plug and check the oil level.
4. The oil level must reach the rim of the level check/filler opening (A).
5. After checking the oil level, tighten the level check plug to the specified torque. See “Technical data”.



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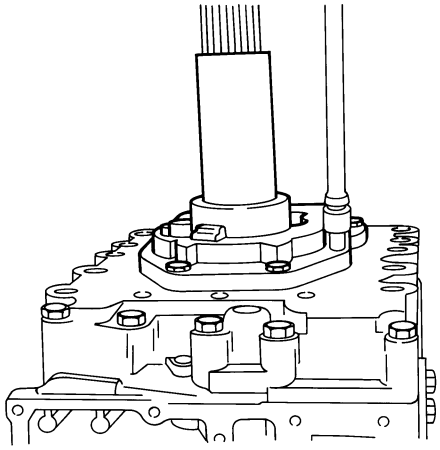
3.2 INSPECTION AND ADJUSTMENT, INPUT SHAFT BEARING AXIAL CLEARANCE

Inspection and adjustment, input shaft bearing axial play

1. Remove the gearbox. See “Removal and installation”.
2. Remove the gearbox front cover attachment bolts and slide the cover off the input shaft.



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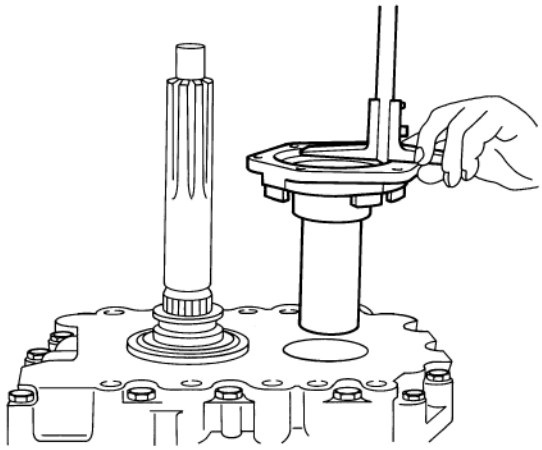
3. Use a depth gauge to determine the depth of the recess in the gearbox front cover. Make a note of this measurement.



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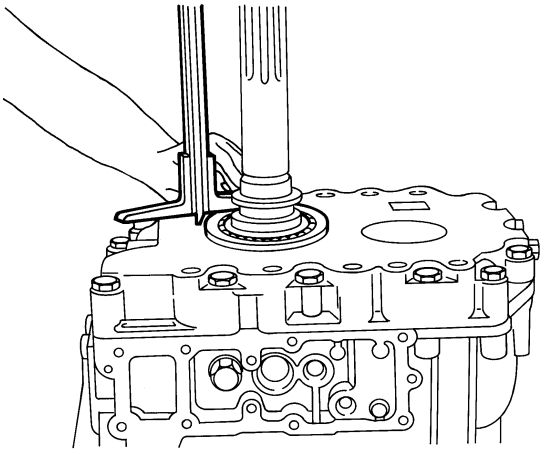
4. Install a new gasket in the gearbox housing. Using a depth gauge, measure the height that the ball bearing protrudes above the gearbox housing and deduct this measurement from the measurement taken in point 3.
5. Calculate the axial play. Compare the calculated value with the maximum allowable axial play. See “Technical data”.



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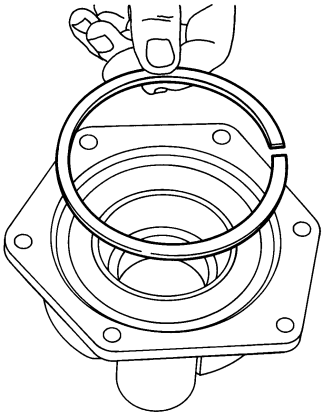
6. If necessary, adjust the axial play by means of another adjusting ring.
7. Install a new gasket and the adjusting ring into the gearbox front cover and fit it to the gearbox.
8. Install the attachment bolts and tighten them to the specified torque. See “Technical data”.
9. Fit the gearbox. See “Removal and installation”.



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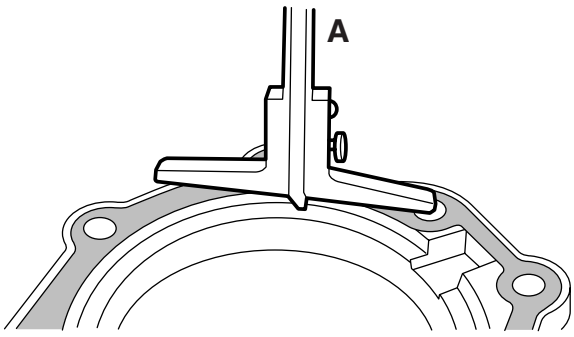
3.3 INSPECTION AND ADJUSTMENT, GEARBOX OUTPUT SHAFT BEARING AXIAL CLEARANCE

Inspection and adjustment, output shaft bearing axial play

1. Remove the rear gearbox bearing cover.
2. Install a new gasket on the bearing cover.
3. Use a depth gauge to determine the depth of the bearing cover recess, distance A.
4. Use a depth gauge to determine the height the ball bearing protrudes above the gearbox housing, distance B.
5. Calculate the axial play.
6. The axial play equals distance A – distance B.
7. Compare the calculated value with the maximum allowable axial play. See “Technical data”.
8. If necessary, adjust the axial play by means of another adjusting ring.



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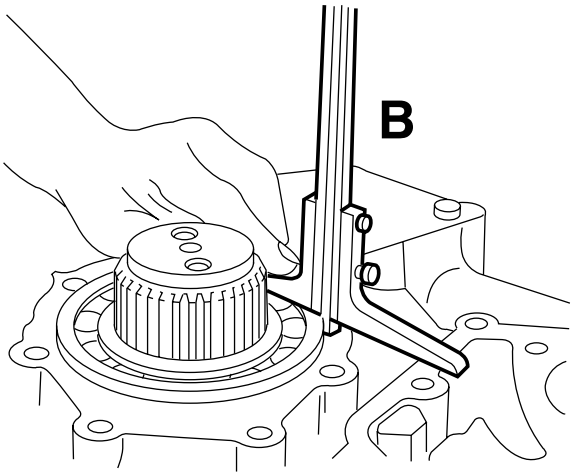

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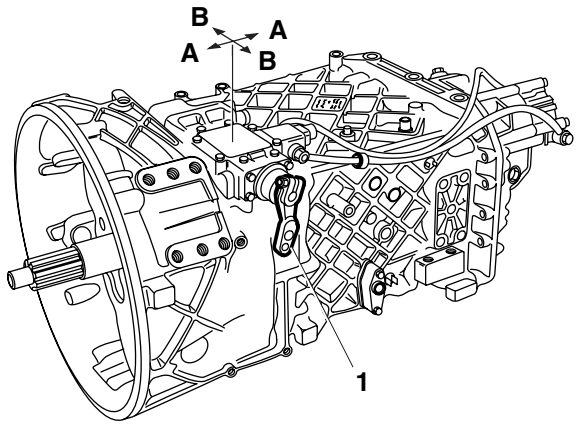
3.4 INSPECTION AND ADJUSTMENT, SELECTOR SHAFT HOUSING ON GEARBOX

Inspection of selector shaft housing on gearbox

1. Slacken the shift control from the lever (1).
2. Check in 5th and 6th gear how far the lever (1) can still be pressed through. The transfer (P) should be identical in both gears.



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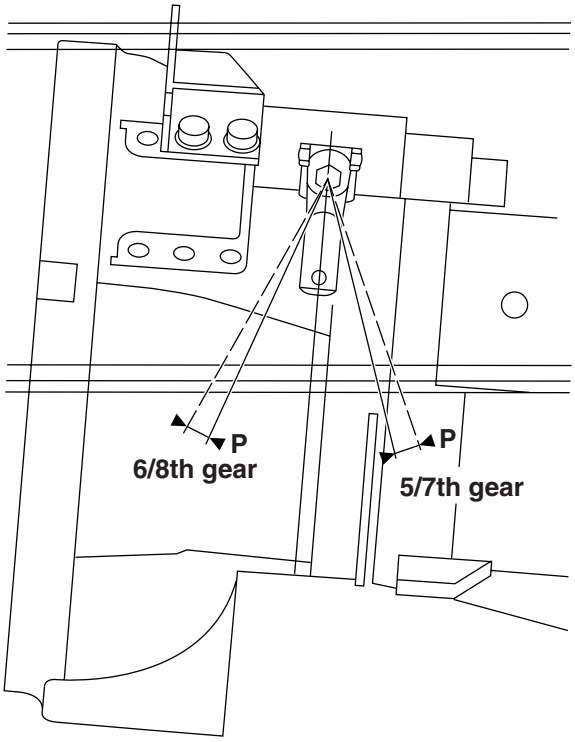
Adjustment of selector shaft housing on gearbox

Note:
If the transfer (P) is different, carry out the following procedure.

1. Slacken the attachment bolts of the selector housing slightly.
2. Shift the selector housing forwards or backwards as such that this transfer is identical in both gears (direction A-A).
3. Then repeat point 2 for the 7th and 8th gears.
4. If 1st or 2nd gear cannot be engaged, the selector housing must be shifted transversely (direction B-B).
5. Tighten the selector housing attachment bolts.
6. Check by hand whether the selector shaft will lightly and easily spring back into its rest position.
7. Check that the travel is about the same in all gears.
8. Repeat the entire procedure, if necessary.

   Note:
   For an improved retention it is possible to fit a heavier retaining spring (191N instead of 168N) (DAF No. 1341343).
9. Fit the shift control.



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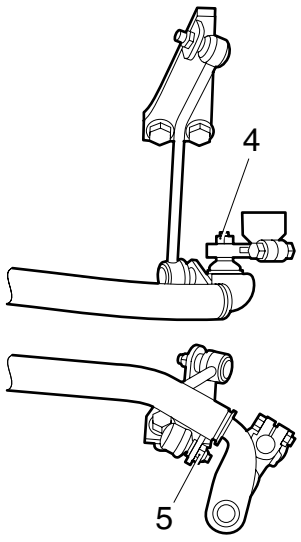
4. REMOVAL AND INSTALLATION, GEARBOX

4.1 REMOVAL AND INSTALLATION , ENTIRE GEARBOX

Removing the entire gearbox

1. Make sure there are no loose items in the cab. Tilt the cab.
2. Disconnect the negative terminal of the battery.
3. Disconnect the prop shaft and flange from the gearbox.
4. Remove the clutch servo without disconnecting the pipes.
5. Disconnect the tachometer connection from the gearbox.
6. Disconnect the gearbox wiring harness connector.
7. Remove the various air pipes. Pipes that are not recognisable must be marked.
8. Disconnect the selector rod from the operating lever and the torque rod bracket from the gearbox. Hang the gearbox control on the chassis.
9. Remove the exhaust pipe between the engine brake and silencer (depending on the vehicle type).
10. Place a jack under the gearbox and remove the bolts around the clutch housing.
11. Use the jack to pull the gearbox from the engine and remove the gearbox.



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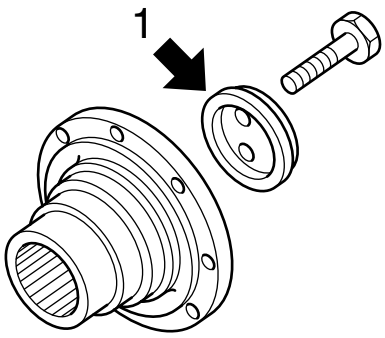
Installing the entire gearbox

1. Before positioning the gearbox, one gear should be engaged in order to allow the input shaft to slide into the clutch plate during installation. Also grease the input shaft sparingly with the specified grease. See “Technical data”.
2. Fit the exhaust pipe between the engine brake and the silencer (depending on the vehicle type).
3. Fit the selector rod and torque rod.
4. Fit the air pipes.
5. Fit the gearbox connectors and the tachometer connection.
6. Fit the clutch servo.
7. Fit the prop shaft flange to the gearbox. Tighten the attachment bolts to the specified torque. See “Technical data”.
8. Connect the negative terminal of the battery.
9. Check the oil level after installing the gearbox.
10. Inspect the shift control. See “Inspection and adjustment”.
11. If a gearbox of a different type is mounted, or a gearbox with a different reduction, this should be reported. If the correct data are present, they can be input into the VIC using DAVIE XD.

4.2 REMOVAL AND INSTALLATION, DRIVE FLANGE

Removing the drive flange

1. Detach the prop shaft from the flange and secure it.
2. Hold the drive flange in place with special tool (DAF No. 0484977).
3. Remove the bolts and lock plate from the drive flange.
4. Remove the O-ring.
   Recommendation: measure and note the distance from flange to shaft. The same distance must be observed when the flange is reinstalled. Then the flange will be fitted far enough on the shaft.
5. Pull the flange from the shaft with a commercially available puller.

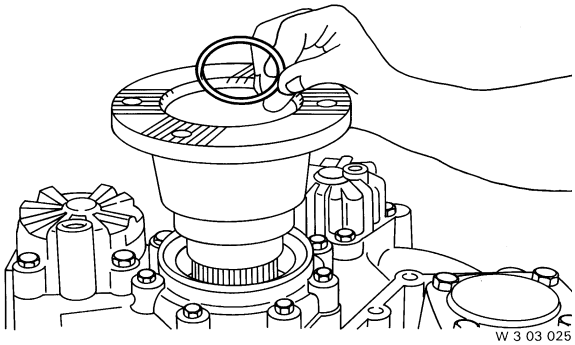


V300357

Installing the drive flange

1. Lightly oil the oil seal in the bearing cover.
2. Heat the drive flange to 70°C. Slide the flange as far as possible onto the output shaft. With the locking plate and two standard bolts, pull the flange further onto the shaft. Check the position of the flange, comparing it with the above-mentioned measurement in point 5. Remove the locking plate and bolts.
3. Press the new O-ring into the slot between the shaft and flange.
4. Hold the drive flange in place with special tool (DAF No. 0484977).

   Note:
   For the new gearboxes the attachment bolts are no longer locked with a locking plate, but with self-locking screw thread in the output shaft.
   When the drive flange is removed during overhaul, the bolts must always be locked afterwards with a locking plate.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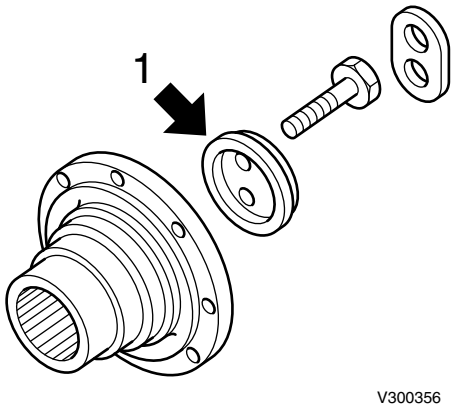
5. Apply a suitable locking compound between the rear of the washer (1) and the drive flange. See “Technical data”.

6. Install the locking plate with the bolts and tighten them to the specified torque. See “Technical data”.

   Note:
   Bolts that will be re-used must be cleaned and lightly oiled.



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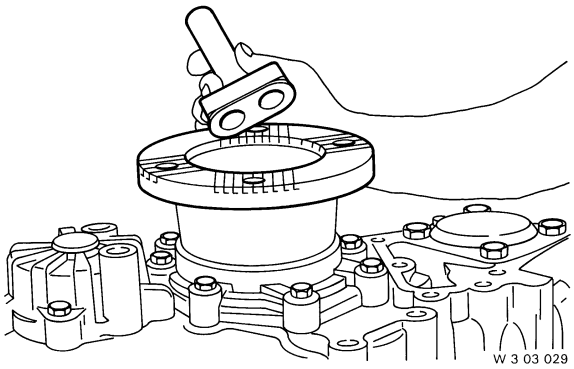
7. Fit a new locking plate (DAF No. 0699725) with stamp over the bolt heads.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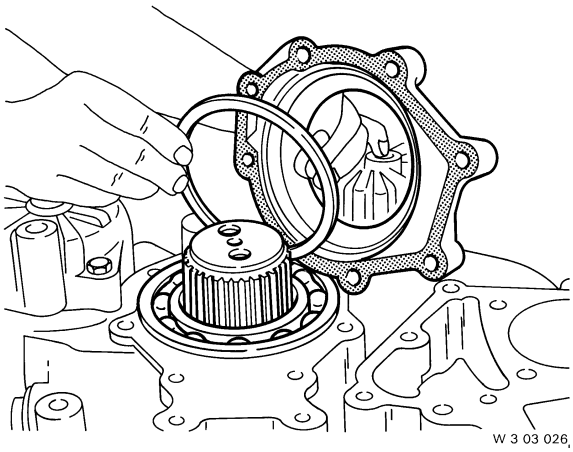
4.3 REMOVAL AND INSTALLATION, OUTPUT SHAFT OIL SEAL

Removing the output shaft oil seal

1. Detach the prop shaft from the flange and secure it.
2. Remove the drive flange.
3. Remove the attachment bolts from the area of the bearing cover.
4. Tap the bearing cover with a plastic mallet.
5. Remove the bearing cover, shim and oil seal.
6. Drive the oil seal out of the cover with a plastic driver.

Installing the output shaft oil seal

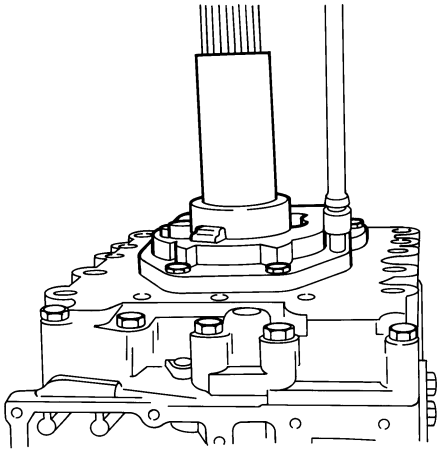
1. Fit the oil seal in the bearing cover using special tool (DAF Nos. 1240491 and 1240483). Apply small amount of liquid gasket to the oil seals fitted with a steel sleeve on the outside.
2. Apply a rubber coating to the oil seals' exterior and apply green soap sparingly.
3. Check the output shaft bearing play. See "Inspection and adjustment".
4. Fit a new gasket to the bearing cover and install the bearing cover and adjusting ring to the gearbox housing.
5. Fit the attachment bolts and tighten to the specified torque. See "Technical data".
6. Fit the drive flange.
7. Attach the prop shaft.



4.4 REMOVAL AND INSTALLATION, GEARBOX FRONT COVER SEALING RING

Removing the gearbox front cover oil seal

1. Remove the gearbox.
2. Disconnect the clutch housing from the gearbox.
3. Remove the attachment bolts from the gearbox front cover.
4. Remove the entire gearbox front cover with the gasket and shim.
5. Remove the oil seal from the gearbox front cover.



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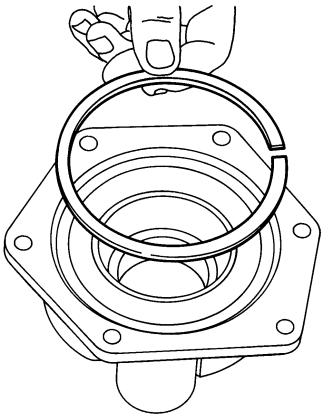
Installing the gearbox front cover oil seal

1. Pull the oil seal into the gearbox front cover using the special tool (DAF No. 0535423). Apply small amount of liquid gasket to the oil seals fitted with a steel sleeve on the outside. Apply a rubber coating to the oil seals' exterior and apply green soap sparingly.
2. Slide the entire gearbox front cover with oil seal, adjusting ring and gasket over the input shaft into its place. Install the attachment bolts and tighten them to the specified torque. See "Technical data".
3. Fit the clutch housing.
4. Fit the gearbox.



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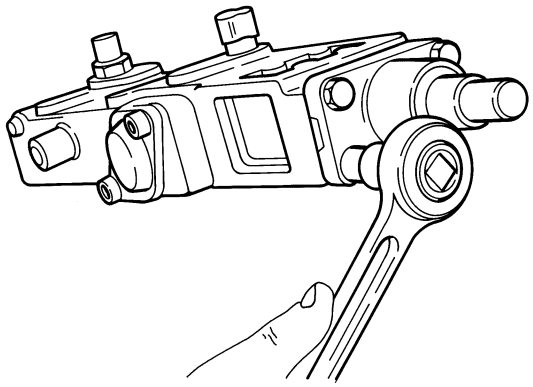
4.5 REMOVAL AND INSTALLATION, SELECTOR SHAFT OIL SEAL

Removing the selector shaft oil seal

1. Disconnect the shift control from the gearbox lever in the area of the ball joint.
2. Mark the selector shaft lever in relation to the selector shaft. Remove the selector shaft lever.
3. Loosen the bolts of the oil seal cover and remove the cover.
4. Check the selector shaft for damage. Lightly sand the shaft, if necessary, with fine sand paper.
5. Drive the oil seal out and inspect the bearing bush.



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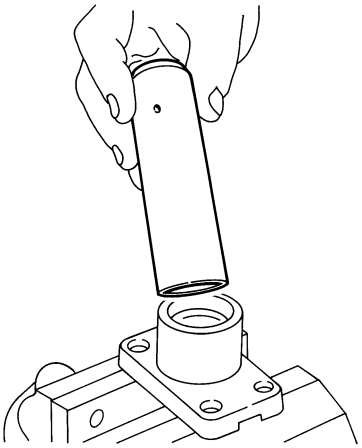
Installing the selector shaft oil seal

1. Sparingly apply a liquid gasket to the oil seal and fit it in the bearing housing using special tool (DAF No. 0535659). Now fit the dust seal in the bearing housing using special tool (DAF No. 0535659).
2. Carefully slide the cover over the selector shaft and hand-tighten the bolts. Move the selector shaft from one side to the other several times, allowing the cover to centre itself. Tighten the attachment bolts to the specified torque.
3. Fit the gearbox control and tighten the ball joint nut to the specified torque.
4. Fit the selector shaft lever. See “Inspection and adjustment”.



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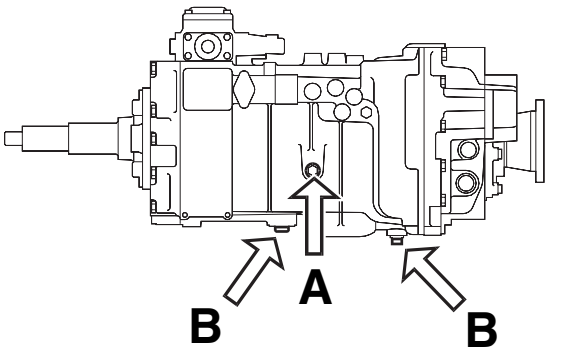
5. DRAINING AND FILLING

5.1 DRAINING AND FILLING, GEARBOX

To prevent skin injury, avoid unnecessary contact with the drained oil.

ZF 8/9/16S-109 gearbox
Draining, gearbox

1. Position the vehicle on a level surface.
2. Drain the gearbox at operating temperature.
3. Remove the level check/filler plug (A) and drain plugs (B) and drain the oil.



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Filling, gearbox

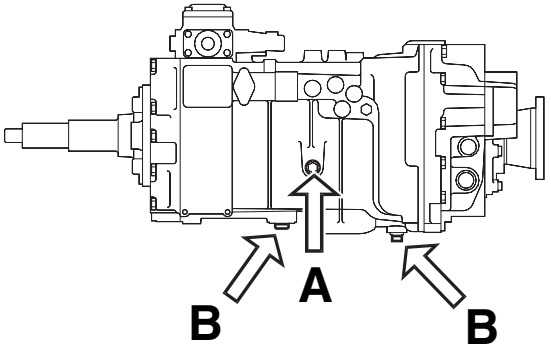
1. Clean the drain plugs (B) and tighten them to the specified torque. See “Technical data”.
2. Top up oil through the level check/filler opening (A) until the oil reaches the rim of the filling opening.
3. Fit the level check/filler plug (A), tightening it to the specified torque. See “Technical data”.

6

5.2 GEARBOX ZF 8/9/16S-109 WITH INTEGRATED RETARDER

Draining, gearbox

1. Before draining take a short test drive. **Do not** activate the retarder during the test drive.
2. Position the vehicle on a level surface.
3. Drain the gearbox at operating temperature.



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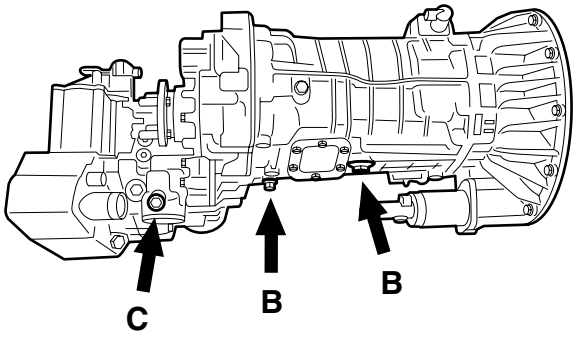
4. Remove the drain plugs (B and C) and the level check/filler plug (A) and drain the oil.



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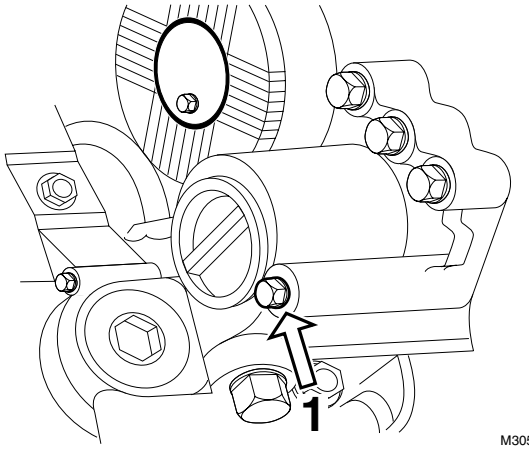
5. Replace the oil filter. See “ZF Intarder”.

Filling, gearbox

1. Clean the drain plugs and tighten them to the specified tightening torque. See “Technical data”.
2. Top up oil through level check/filler opening (A) until the oil reaches the rim of the filler opening (A).
3. Fit the level check/filler plug (A), tightening it to the specified torque. See “Technical data”.
4. After filling take a short test drive. **Do not** activate the intarder during the test drive.
5. Check the oil level after taking the test drive. The oil level must reach the rim of the level check/filler opening (A).
6. Fit the level check/filler plug (A), tightening it to the specified torque. See “Technical data”.



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CONTENTS

		Page	Date
1.	**GENERAL**	1-1	200337
1.1	System description	1-2	200337
2.	**DESCRIPTION OF COMPONENTS**	2-1	200337
2.1	Synchroniser	2-1	200337
3.	**INSPECTION AND ADJUSTMENT**	3-1	200337
3.1	Inspection of gearbox oil level	3-1	200337
3.2	Inspection and adjustment, input shaft bearing axial play	3-3	200337
3.3	Inspection and adjustment, gearbox output shaft bearing axial play	3-4	200337
3.4	Inspection and adjustment, selector shaft housing on gearbox	3-5	200337
4.	**REMOVAL AND INSTALLATION OF GEARBOX**	4-1	200337
4.1	Removal and installation, gearbox assembly with or without integrated retarder	4-1	200337
4.2	Removal and installation, prop shaft flange	4-4	200337
4.3	Removal and installation, output shaft oil seal	4-6	200337
4.4	Removal and installation, gearbox front cover oil seal	4-7	200337
4.5	Removal and installation, selector shaft oil seal	4-8	200337
5.	**DRAINING AND FILLING**	5-1	200337
5.1	Draining and filling, gearbox	5-1	200337

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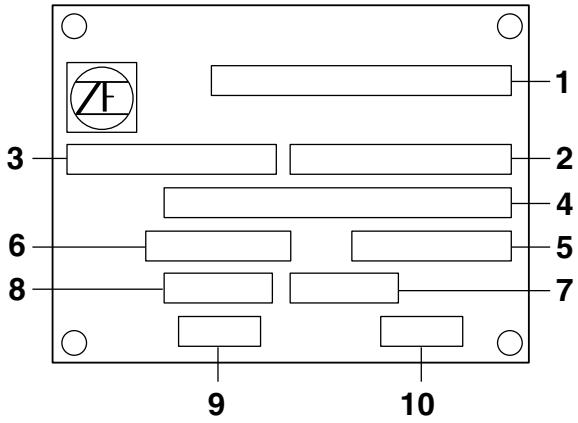
1. GENERAL

Gearbox type
Each gearbox has a type-plate attached to it, indicating the type of gearbox. This data is also stated on the identity card of the relevant vehicle.

ZF gearbox type-plate
1. Type of gearbox
2. Series no. (ZF)
3. Parts list (ZF)
4. Specification no.
5. Pulse generator ratio
6. Gearbox ratio
7. Engine speed using PTO
8. PTO speed
9. Gearbox oil capacity
10. Oil specification



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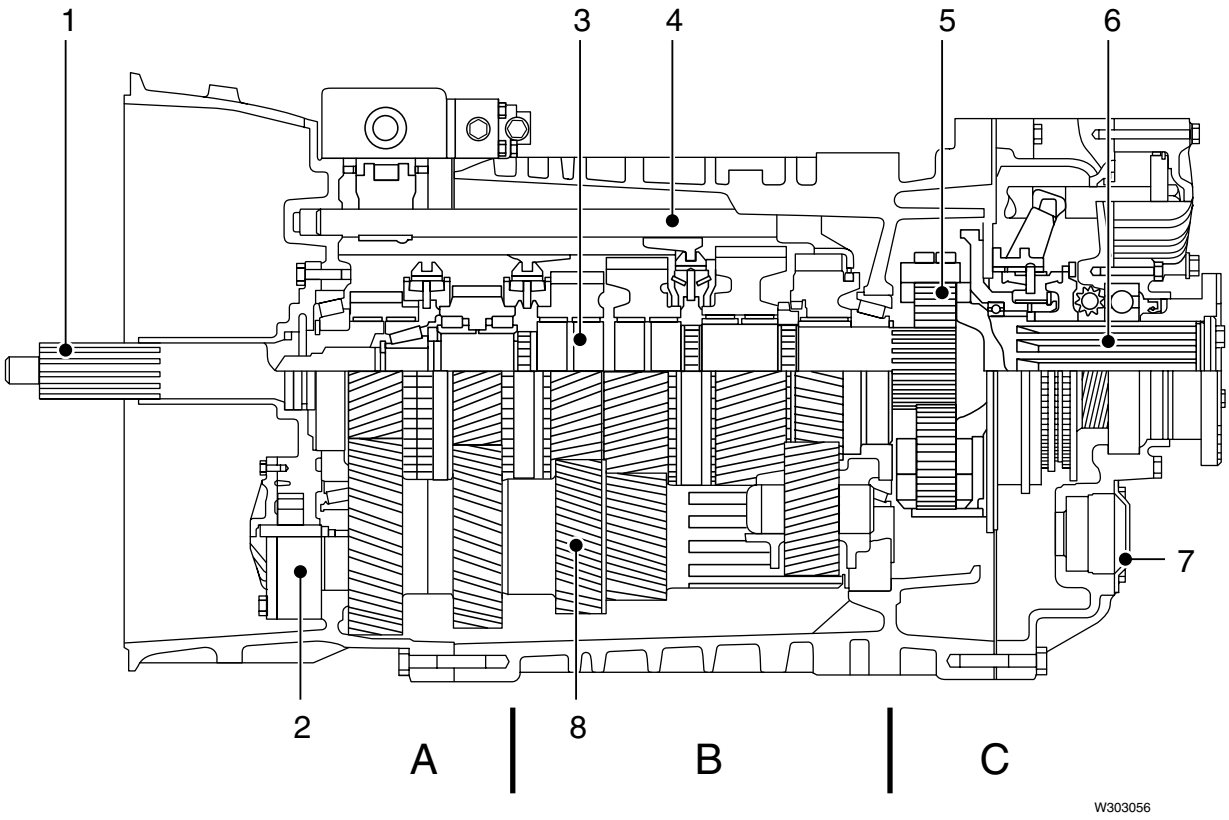
1.1 SYSTEM DESCRIPTION



A. Integrated front-mounted range box or splitter range (two gears)
B. Main box with four forward gears and one reverse gear
C. Rear-mounted range box or range group (two gears)

1. Input shaft
2. Lubricating oil pump
3. Main shaft
4. Selector shafts with shifting forks
5. Planetary gears for range group
6. Output shaft
7. PTO connection point
8. Auxiliary shaft

Example of type designation 16S-181

16	=	16 gears
S	=	all forward gears are synchromesh
181	=	mark for the input engine torque

A. Integrated front-mounted range box
This is a front-mounted range box located in the main box housing. Using an additional set of gears, the auxiliary shaft of the main box can be driven by two different ratios. In this way, each gear in the main box can be engaged in a low or high ratio, i.e. split into two. The number of gears in the main box is thereby doubled.

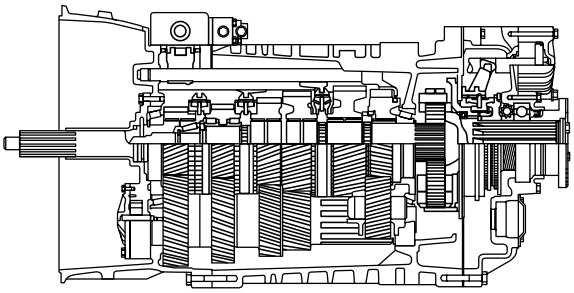
B. Main box
The main box consists of four synchromesh forward gears, and one non-synchromesh reverse gear.

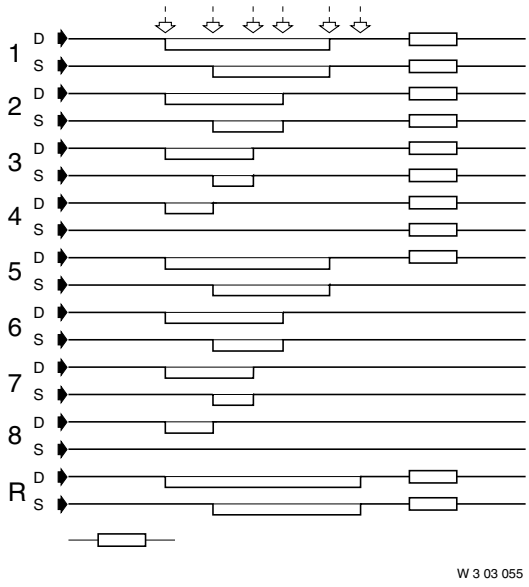
C. Planetary rear-mounted range box
This is a range box mounted against the rear of the main box, consisting of a planetary gear wheel set.

Using this set of gears, all gears of the main box can be used once with the rear-mounted range box in a low ratio and once with the rear-mounted range box in a 1:1 ratio.
The number of gears in the main box is thereby doubled.

In popular terms, the number of gears in the main box is “stacked”. This is why the term “stacking box” or range box was created.

16S-151/181/221
By means of the splitter range, the four gears in the main box are multiplied by two, while using the rear-mounted range box multiplies this figure by two again. This results in 4x2x2 = 16 forward gears.





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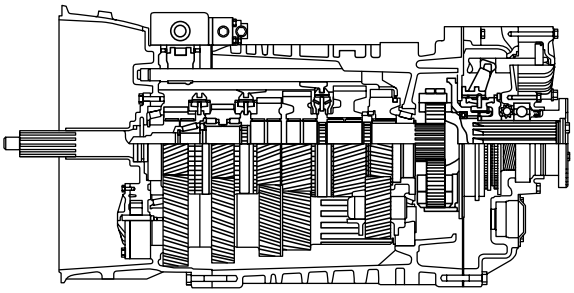
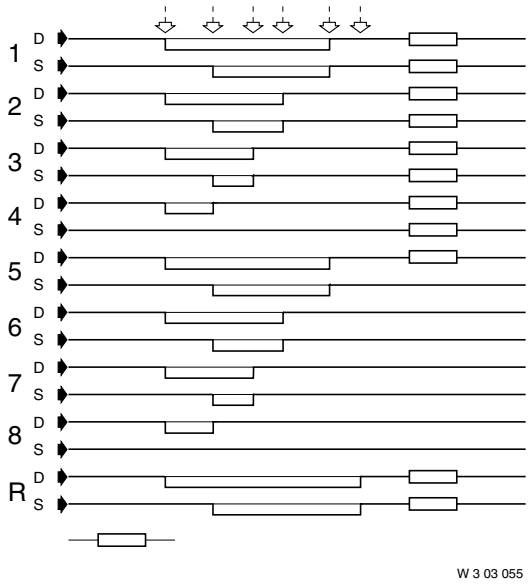
8S-151/181
The four gears of the main box are multiplied by 2 due to the addition of a rear-mounted range box, creating 4x2 = 8 or, if the crawler gear is counted, 9 forward gears.

The diagram shows the power distribution across the individual gear pairs for each gear.

Direct input shaft version of the ZF 16S-151
D = splitter “Direct”
S = splitter “Fast”





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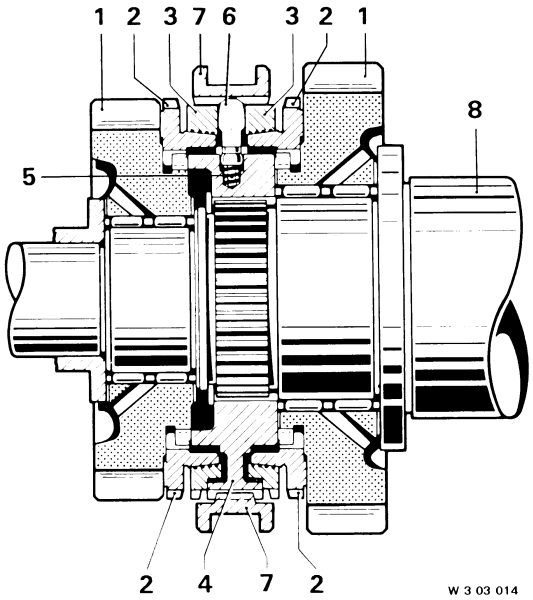
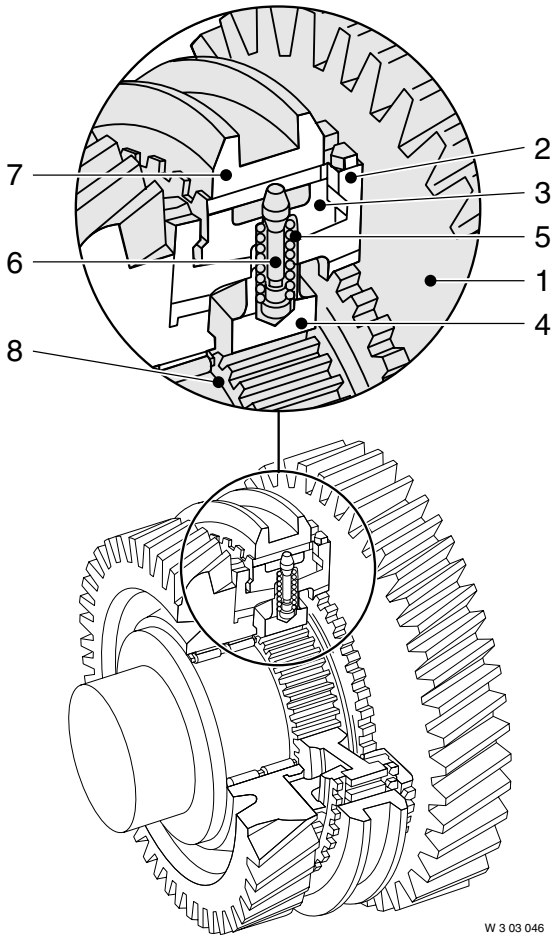
2. DESCRIPTION OF COMPONENTS

2.1 SYNCHRONISER

B-lock synchronisation
The synchroniser consists of the following parts:
1. Gear
2. Selector ring
3. Synchromesh ring
4. Selector sleeve support
5. Pressure spring
6. Thrust piece
7. Selector sleeve
8. Main shaft



In neutral, the selector sleeve (7) is in the centre position.
Pressure springs (5) push the thrust pieces (6) into a wedge-shaped recess in the selector sleeve (7).
The gear wheels (1) and corresponding selector rings (2) move freely around the main shaft (8).
If the selector sleeve (7) is shifted to the right from the neutral position, the synchromesh ring (3) is pushed against the friction cone of the selector ring (2) by the thrust pieces (6).
The difference in speed immediately turns the synchromesh ring (3) as far as a stop on the selector sleeve support (4), which is not in the figure, and thus prevents further movement of the selector sleeve (7).



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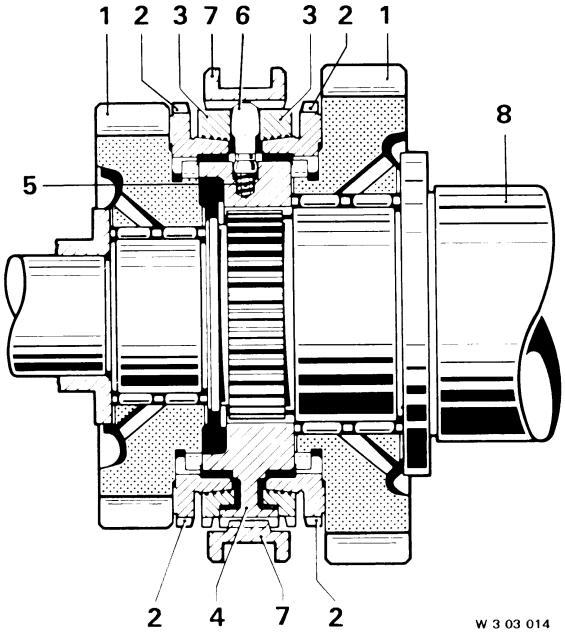
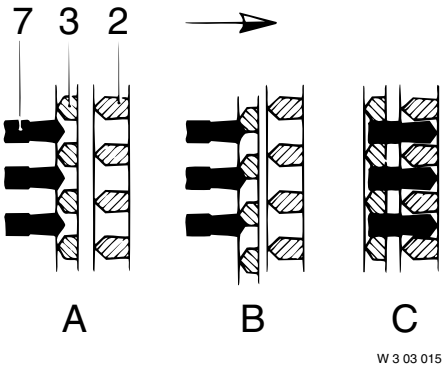
As a result of continued pressure on the selector sleeve (7) (friction), the speed of the gear (1) to be shifted with the selector ring (2) matches the speed of the main shaft (8).
The bevelled sides of the teeth on the synchromesh ring (3) and the selector sleeve (7) cause the synchromesh ring (3) to be turned back slightly after synchronisation.
This releases the lock and allows the selector sleeve (7) to be moved into the teeth of the selector ring (2).
As a result, the relevant gear is engaged.



A. Not connected
B. Synchronising
C. Connected



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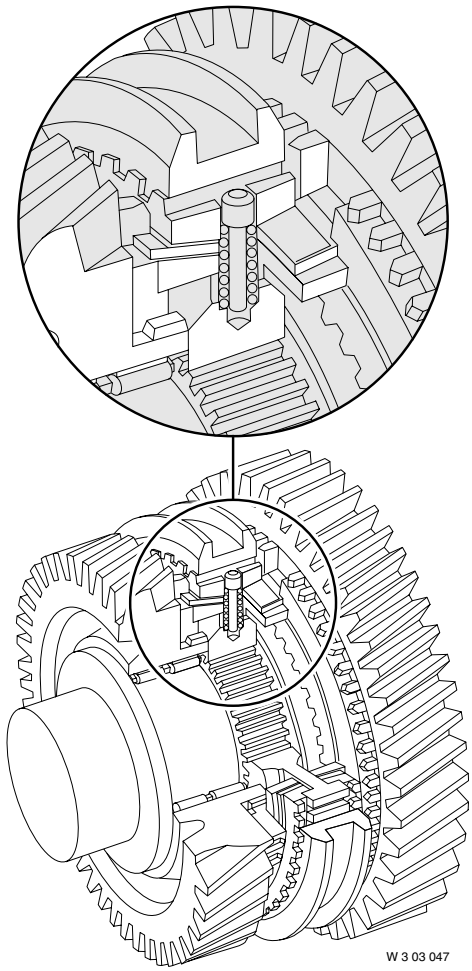
Double-cone synchronisation
As a result of the speed difference to be eliminated in the lower gears, the synchronisation forces may be considerable. In order to achieve effective synchronisation, a synchroniser with a double cone is used.
This synchroniser consists of an outer and an inner ring (synchromesh rings) connected to the main shaft of the gearbox by means of the selector sleeve support.
The ring between the two synchromesh rings is connected to the gear wheel by means of the selector ring.
When the selector sleeve moves into the selector ring, two synchronisation surfaces are active.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3. INSPECTION AND ADJUSTMENT

3.1 INSPECTION OF GEARBOX OIL LEVEL

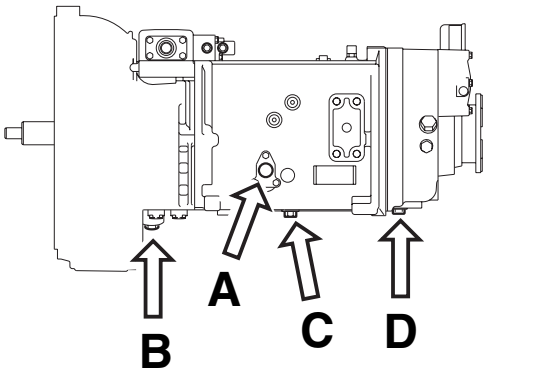
To prevent skin injury, avoid unnecessary contact with the drained oil.

ZF 8S/16S-151/181 and 16S-221 gearboxes

1. Position the vehicle on a level surface.
2. Wait for some minutes to allow the oil to flow back.

Note:
The oil level must reach the rim of the level check/filler opening (A).

3. Remove the level check plug (A) and check the oil level.
4. After checking the oil level, tighten the level check plug to the specified torque. See “Technical data”.



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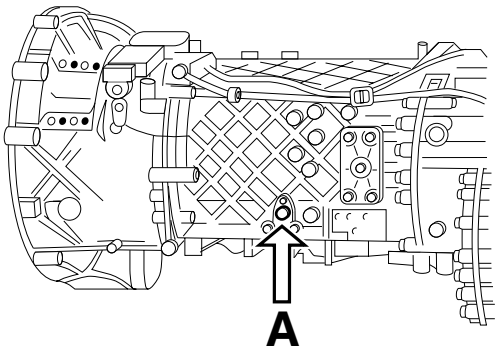
ZF 8S/16S-151/181 and 16S-221 gearboxes with integrated retarder

1. Place the vehicle on a level surface. Apply the brakes without activating the retarder.
2. Wait for some minutes to allow the oil to flow back.

Note:
The oil level must reach the rim of the level check/filler opening (A).

3. Remove the level check plug (A) and check the oil level.
4. After checking the oil level, tighten the level check plug to the specified torque. See “Technical data”.



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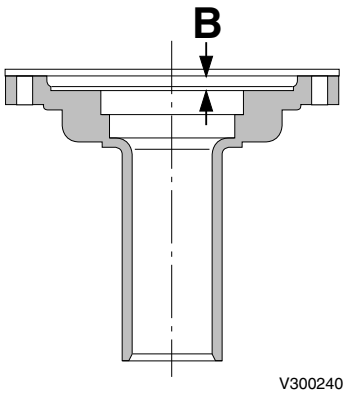
3.2 INSPECTION AND ADJUSTMENT, INPUT SHAFT BEARING AXIAL PLAY

Inspection and adjustment, input shaft bearing axial play

1. Remove the gearbox front cover.
2. Use a depth gauge to determine the depth of the recess in the gearbox front cover, distance B.



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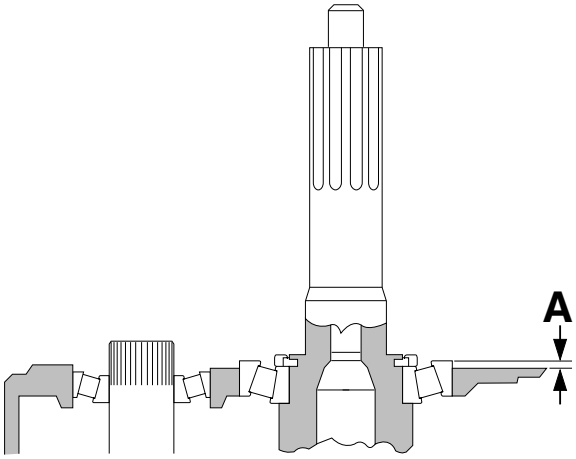
3. Install a new gasket in the gearbox housing. Use a depth gauge to determine the height the ball bearing protrudes above the gearbox housing, distance A.
4. Calculate the axial play. The axial play equals distance B - distance A.
5. Compare the calculated value with the maximum allowable axial play. See “Technical data”.
6. If necessary, adjust the axial play by means of another adjusting ring.



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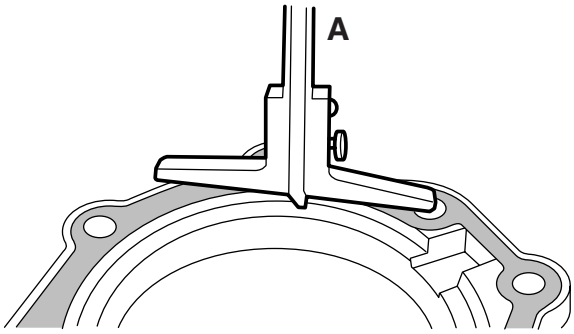
3.3 INSPECTION AND ADJUSTMENT, GEARBOX OUTPUT SHAFT BEARING AXIAL PLAY

1. Remove the rear gearbox bearing cover.
2. Install a new gasket on the bearing cover. Use a depth gauge to determine the depth of the bearing cover recess, distance A.



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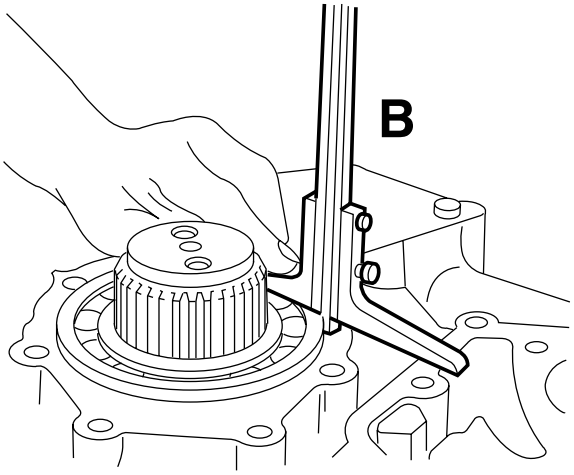
3. Use a depth gauge to determine the height the ball bearing protrudes above the gearbox housing, distance B.
4. Calculate the axial play. The axial play equals distance A - distance B.
5. Compare the calculated value with the maximum allowable axial play. See “Technical data”.
6. If necessary, adjust the axial play by means of another adjusting ring.



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3.4 INSPECTION AND ADJUSTMENT, SELECTOR SHAFT HOUSING ON GEARBOX

Inspection of selector shaft housing on gearbox

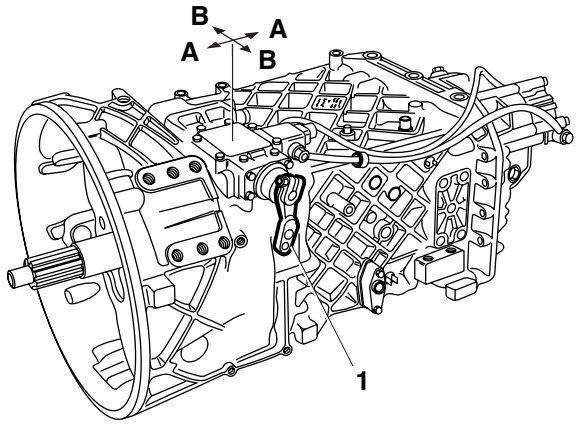
1. Slacken the shift control from the lever (1).
2. Check in 5th and 6th gear how much further the lever (1) can be pressed. The transfer (P) should be identical in both gears.

Adjustment of selector shaft housing on gearbox

Note:
If the transfer (P) is different, carry out the following procedure.

1. Slacken the attachment bolts of the selector housing slightly.
2. Shift the selector housing forwards or backwards until this transfer is identical in both gears (direction A-A).
3. Now repeat point 2 for 7th and 8th gears.
4. If 1st or 2nd gear cannot be engaged, the selector housing must be shifted transversely (direction B-B).
5. Tighten the selector housing attachment bolts.
6. Check by hand whether the selector shaft will lightly and easily spring back into its rest position.
7. Check that the travel is about the same in all gears.
8. Repeat the entire procedure, if necessary.

   Note:
   For improved retention a heavier retaining spring (191N instead of 168N) may be fitted (DAF No. 1341343).
9. Fit the shift control.



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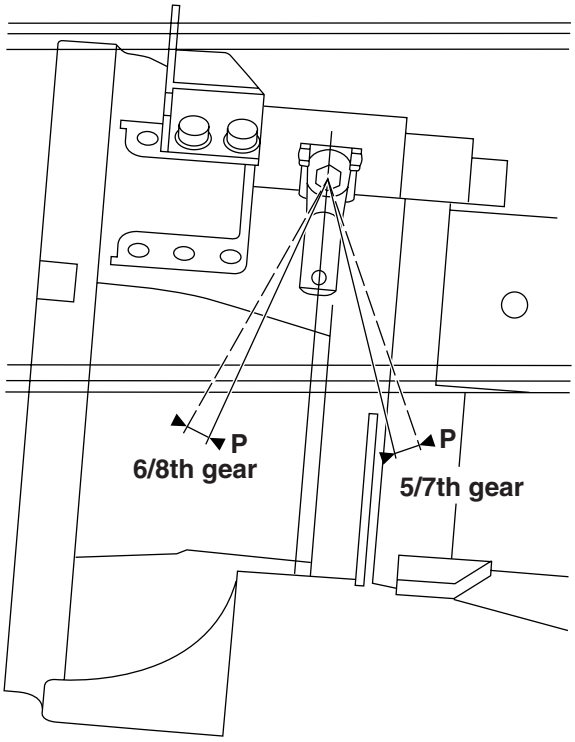

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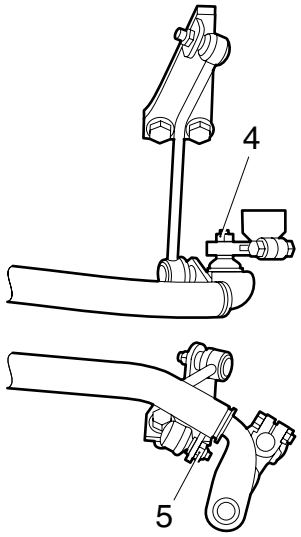
4. REMOVAL AND INSTALLATION OF GEARBOX

4.1 REMOVAL AND INSTALLATION, GEARBOX ASSEMBLY WITH OR WITHOUT INTEGRATED RETARDER

Removing the gearbox assembly

1. Disconnect the negative lead from the battery terminal.
2. Disconnect the prop shaft from the gearbox flange and hang it on the chassis.
3. Remove the clutch servo without disconnecting the pipe. Remove the attachment bolts from the clutch servo and hang the clutch servo assembly on the chassis.
4. Disconnect the connectors of the gearbox wiring harness.
5. Disconnect the air pipes from the central air distribution block at the side of the gearbox, or, in the case of an integrated air distribution block on the selector shaft housing, the central air supply at the side of the integrated air distribution block.
6. Remove the ball joint of the control rod (4) on the selector shaft lever and remove the attachment nut (5) of the torque rod on the control rod.
   Hang the gearbox control on the chassis.
7. If necessary, remove the section of the exhaust pipe underneath the gearbox.
8. Place a jack underneath the gearbox and remove the gearbox attachment bolts around the clutch housing.

   Note:
   When the gearbox is removed from the engine, the thrust bearing remains in the clutch release assembly.
9. Use the jack to pull the gearbox away from the engine and remove it.



V300407

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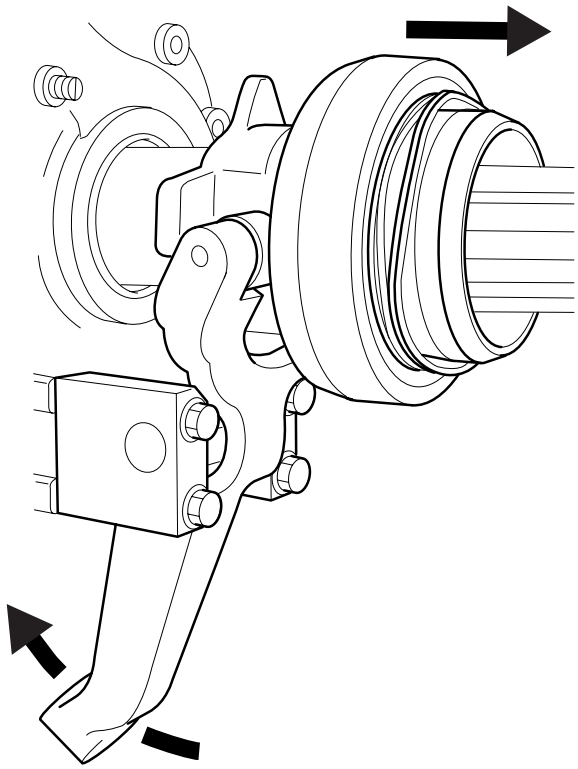
Installing the gearbox

1. Before positioning the gearbox, one gear should be engaged in order to allow the input shaft to slide into the clutch plate during installation.
2. Install the thrust bearing over the gearbox front cover and check whether the circlip in the clutch release assembly is closed.
3. Use the jack to move the gearbox towards the engine and install the attachment bolts around the gearbox.
4. Pull on the clutch lever so as to lock the thrust bearing in the clutch release assembly. When the thrust bearing has been installed in the clutch release assembly, the clutch lever can no longer be moved by hand.
5. Install the clutch servo and tighten the attachment bolts.
6. If the exhaust pipe was removed, reinstall it.
7. Connect the connectors of the gearbox wiring harness.
8. Fit the air pipes from the central air distribution block at the side of the gearbox, or, in the case of an integrated air distribution block on the selector shaft housing, the central air supply at the side of the integrated air distribution block.
9. Fit the control rod ball joint to the selector shaft lever and the nut of the torque rod.
10. Inspect the shift control. See “Inspection and adjustment”.
11. Connect the negative lead to the battery terminal.
12. If a gearbox of a different type is mounted, or a gearbox with a different reduction, this should be reported. If the correct data are present, they can be put back into the VIC using DAVIE XD.



V300442

Removing gearbox with integrated retarder

1. Disconnect the earth lead from the battery terminal.
2. Drain the engine coolant.
3. Remove the coolant pipes from the retarder.
4. Remove the coolant pipes between the retarder and the engine.
5. Disconnect the electrical connectors and remove the air pipes from the retarder.
6. Remove the gearbox assembly with retarder.

Installing the gearbox with integrated retarder

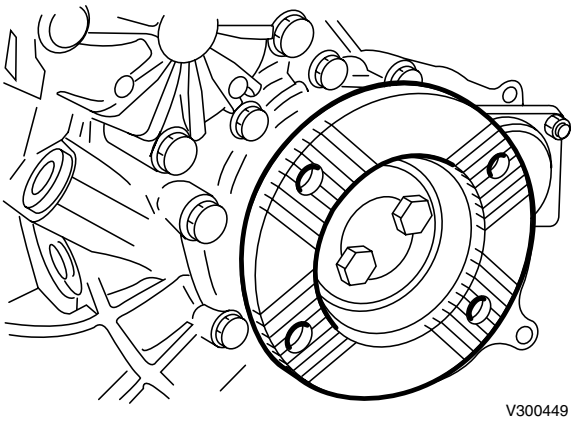
1. Fit the gearbox.
2. Install the coolant pipes between the retarder and the engine.
3. Connect the coolant pipes to the retarder.
4. Connect the electrical connectors and the air pipes of the retarder.
5. Check/fill the gearbox and integrated retarder with oil.
6. Fill the engine cooling system.

4.2 REMOVAL AND INSTALLATION, PROP SHAFT FLANGE

Removing prop shaft flange

1. Remove the prop shaft from the gearbox flange and hang it on the chassis.
2. Hold the prop shaft flange in place with the special tool (DAF No. 0484977).
3. Remove the attachment bolts from the prop shaft flange.
4. Remove the bolts and locking plate from the prop shaft flange.
5. **Note:**
   Measure and make a note of the distance from the prop shaft flange to the shaft. The same distance must be observed when the prop shaft flange is reinstalled.

   Remove the prop shaft flange and O-ring using a commercially available puller.


V300449

Fitting prop shaft flange

1. Lightly oil the oil seal in the bearing cover.
2. Heat the prop shaft flange to 70°C. Slide it as far as possible onto the output shaft. Use the locking plate and two standard bolts (M12x75) to pull the prop shaft flange further onto the shaft.
3. Remove the standard bolts and measure whether the prop shaft flange has reached the correct position on the output shaft.
4. Fit a new O-ring into the recess between the output shaft and the prop shaft flange.

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5. Hold the prop shaft flange in place with the special tool (DAF No. 0484977).

   Note:
   For the new gearboxes the attachment bolts are no longer locked with a locking plate, but with self-locking screw thread in the output shaft.

   When the prop shaft flange is removed during overhaul, the bolts must always be locked afterwards with a locking plate.

6. **Note:**
   Bolts that will be re-used must be cleaned and lightly oiled.

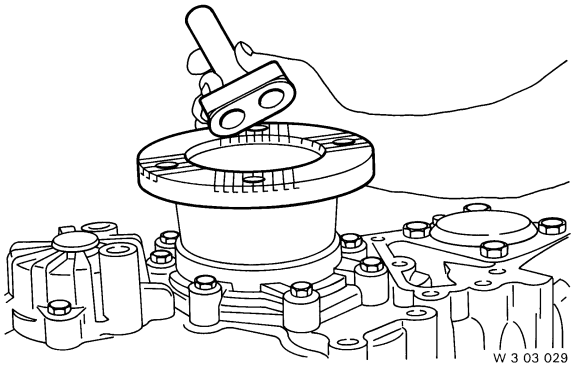
   Tighten the attachment bolts to the specified torque. See “Technical data”.

7. Fit a new locking plate with stamp over the bolt heads.

   Note:
   The following locking plates can be used to lock the prop shaft flange:

Gearbox	DAF No. Locking plate
8/16S-151	0696098
8/16S-181	1227599
16S-221	1227599

8. Attach the prop shaft.



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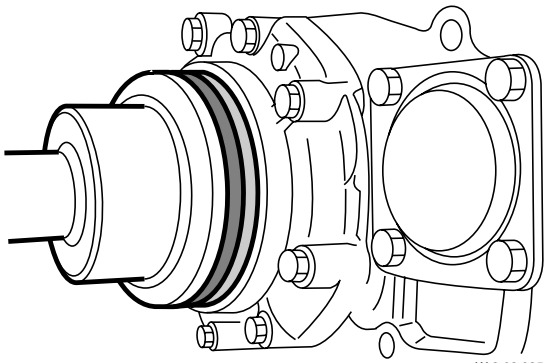
4.3 REMOVAL AND INSTALLATION, OUTPUT SHAFT OIL SEAL

Removing the output shaft oil seal

1. Remove the prop shaft from the gearbox flange and hang it on the chassis.
2. Remove the prop shaft flange.
3. Drill two holes into the external cover of the oil seal and turn the special tool (DAF No. 0484899) into the oil seal. Then pull the oil seal out of the bearing cover using the special tool (DAF No. 0694928).

Installing the output shaft oil seal

1. Apply a small amount of liquid gasket to the outside of oil seals fitted with a steel cover. Apply green soap sparingly to the outside of oil seals fitted with a rubber cover.
2. Pull the oil seal into the bearing cover using the special tool (DAF No. 0694780).
3. Fit the prop shaft flange.
4. Attach the prop shaft.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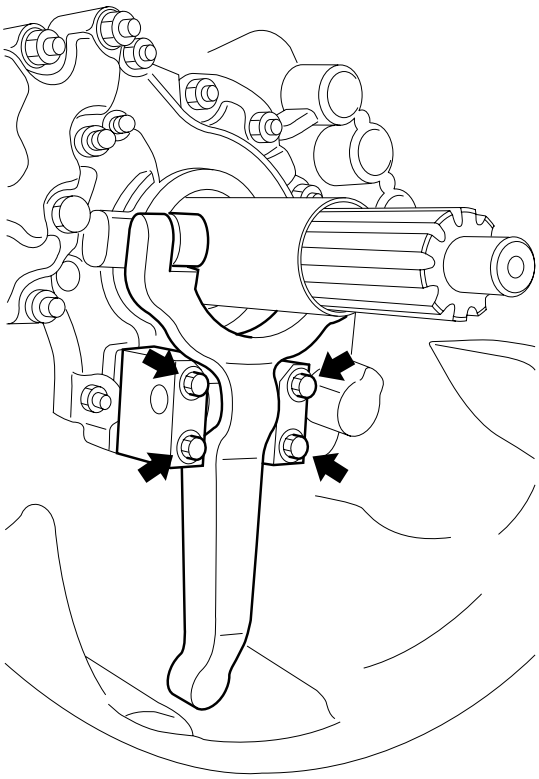
4.4 REMOVAL AND INSTALLATION, GEARBOX FRONT COVER OIL SEAL

Removing the gearbox front cover oil seal

1. Remove the gearbox.
2. Remove the clutch lever from the clutch housing.
3. Remove the attachment nuts from the gearbox front cover and remove the gearbox front cover.
4. Remove the oil seal from the gearbox front cover.
5. Remove the old gasket from the gearbox front cover and/or from the gearbox housing.



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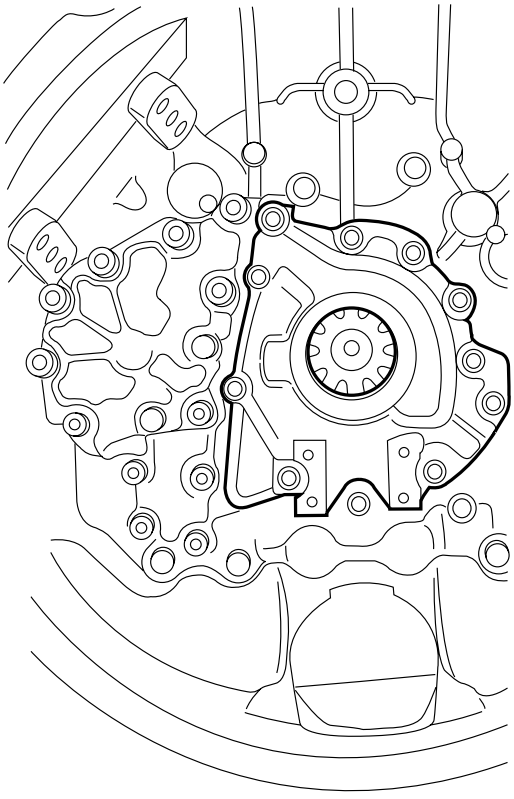
Installing the gearbox front cover oil seal

1. Apply a thin layer of liquid gasket to the outer circumference of the oil seal and install the oil seal in the gearbox front cover using the special tool (DAF No. 0535703).
2. Check the input shaft bearing axial play. See “Inspection and adjustment”.
3. Slide the gearbox front cover over the input shaft and tighten the gearbox front cover to the specified torque. See “Technical data”.
4. Install the clutch lever in the clutch housing.
5. Fit the gearbox.



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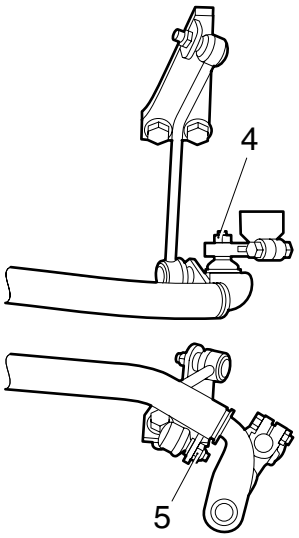
4.5 REMOVAL AND INSTALLATION, SELECTOR SHAFT OIL SEAL

Removing the selector shaft oil seal

1. Remove the ball joint of the control rod on the selector shaft lever and the nut of the torque rod.
   Hang the control rod on the chassis.
2. Remove the locking bolt and, if necessary, the circlip from the selector shaft and remove the selector shaft lever together with the dust cover.
3. Loosen the bolts of the oil seal cover and remove the cover.
4. Check the selector shaft for damage. Lightly sand the shaft, if necessary, with fine abrasive cloth.



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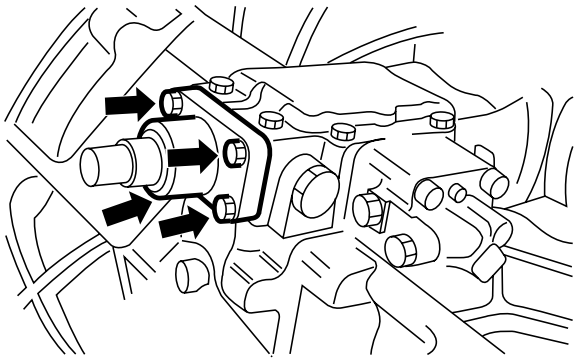
5. Remove the oil seals together with the bearing bush from the cover using the special tool (DAF No. 0535659).
6. Check the bearing bush for damage. Replace if necessary.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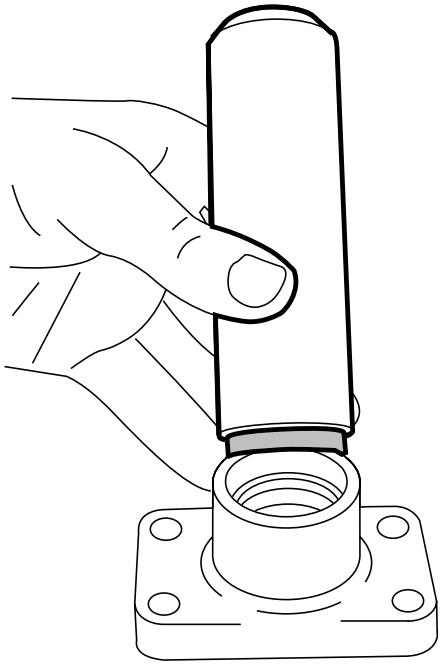
Installing the selector shaft oil seal

1. Fit the bearing bush in the cover using the special tool (DAF No. 0535659).
2. Apply a thin layer of liquid gasket to the outer circumference of the first oil seal to be installed and install it in the cover using the special tool (DAF No. 0535659).
3. Apply a thin layer of liquid gasket to the outer circumference of the second oil seal to be installed and install it in the cover using the special tool (DAF No. 0535659).
4. Apply a thin layer of grease to the inside of both oil seals.
5. Install a new gasket and carefully slide the cover over the selector shaft and hand-tighten the bolts. Move the selector shaft from one side to the other several times, allowing the cover to centre itself. Tighten the attachment bolts to the specified torque. See “Technical data”.
6. Fit the dust cap and the selector shaft lever. Ensure that the dust cap is free of play relative to the selector shaft lever and fit the locking bolt and, if necessary, the circlip.
7. Install the ball joint of the control rod on the selector shaft lever and the nut of the torque rod.
8. Inspect the shift control. See “Inspection and adjustment”.



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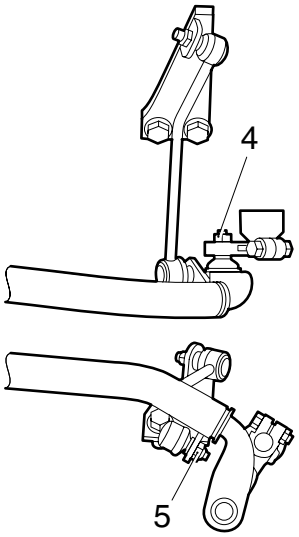

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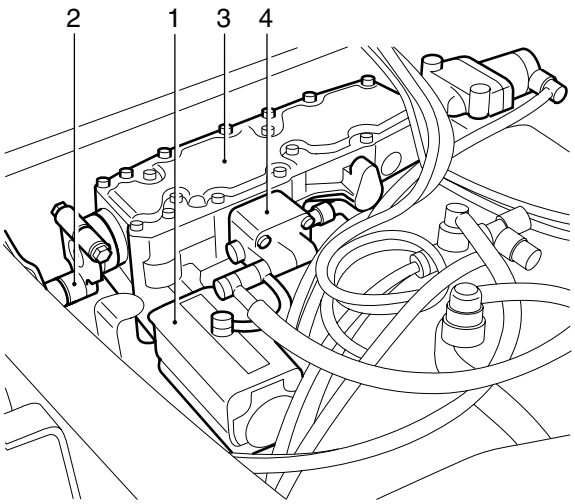
Removing the Servoshift selector shaft oil seal

1. Remove the ball joint of the control rod on the selector shaft lever (2) and the nut of the torque rod. Hang the control rod on the chassis.
2. Ensure that the air supply pipe of the Servoshift unit is pressure-free and remove the banjo bolt.
3. Remove the air pipe from the gate protection locking cylinder.

   Note:
   During removal of the selector housing a small amount of oil will escape.
4. Remove the eight bolts that are used to attach the selector housing to the gearbox. Remove the selector housing with the Servoshift unit from the gearbox.
5. Drill two holes into the seal and, using the special tool (DAF No. 0484899 and DAF No. 0694928), pull the seal out of the selector housing.

   Note:
   Check whether the oil seal has been removed completely.

   The oil seal may have been pulled apart, with the rear part left behind in the housing.
6. Check the selector shaft for damage. Lightly sand the shaft, if necessary, with fine abrasive cloth. In the event of excessive damage the shaft will have to be replaced.
7. Check the selector housing for damage and replace if necessary.



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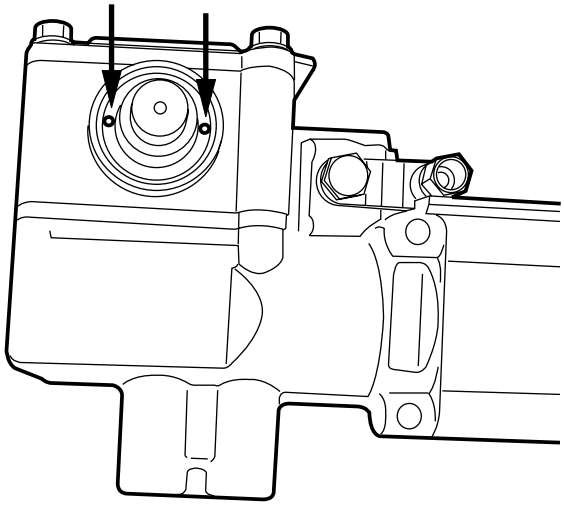
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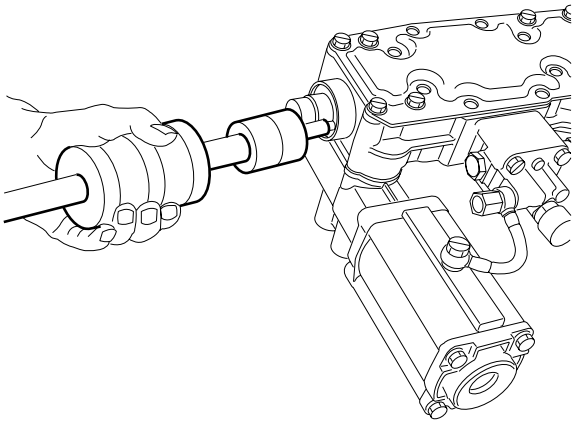
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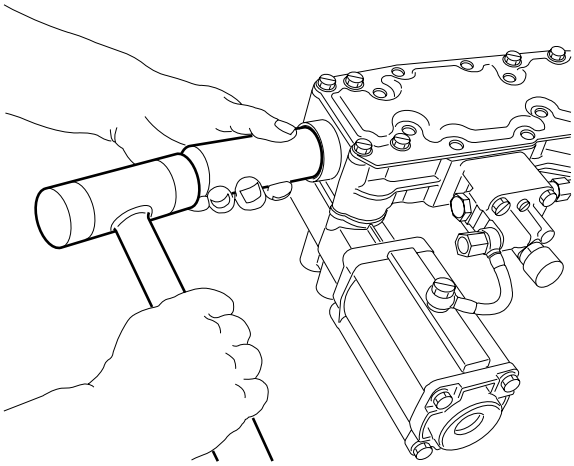
Installing the Servoshift selector shaft oil seal

1. Apply a little grease to the inside of the oil seal.
2. Fit the oil seal into the selector housing using the special tool (DAF No. 1329450).
3. Install the selector housing with a new gasket on the gearbox and tighten the attachment bolts to the specified torque. See “Technical data”.
4. Fit the dust cap and the selector shaft lever on the selector shaft. Ensure that the dust cap is placed without play relative to the shifting arm.
5. Tighten the selector shaft lever locking bolt.
6. Install the torque rod nut.
7. Fasten the air pipes of the Servoshift unit and the locking cylinder of the gate protection with new sealing rings. Pressurise the air circuit and check the operation.



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5. DRAINING AND FILLING

5.1 DRAINING AND FILLING, GEARBOX

To prevent skin injury, avoid unnecessary contact with the drained oil.

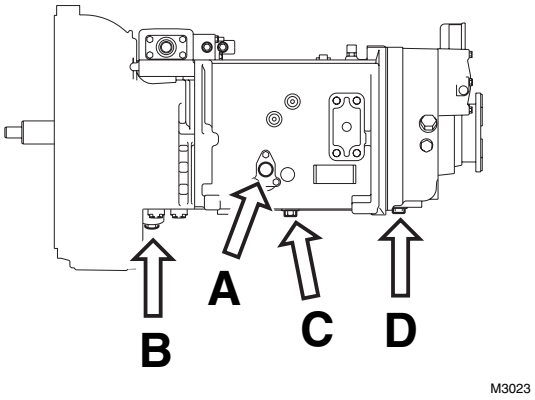
ZF 8S/16S-151/181 and 16S-221 gearboxes

Draining the gearbox

1. Position the vehicle on a level surface.
2. Drain the gearbox at operating temperature.
3. Remove drain plugs B, C and D and the level check/filler plug (A) and drain the oil.

Filling the gearbox

1. Clean drain plugs B, C and D and tighten them to the specified torque. See “Technical data”.
2. Fill the oil through the level check/filler opening (A) until the oil reaches the rim of the filling opening.
3. Fit the level check/filler plug (A), tightening it to the specified torque. See “Technical data”.



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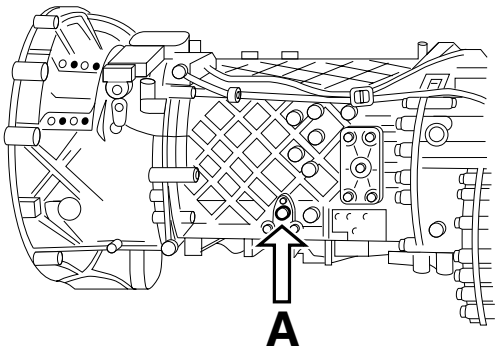
ZF 8/16S-151/181 and 16S-221 gearboxes with integrated retarder

Draining the gearbox

1. Before draining take a short test drive. **Do not** activate the retarder during the test drive.
2. Position the vehicle on a level surface.
3. Drain the gearbox at operating temperature.
4. Remove the drain plugs (B, C and D) and the level check/filler plug (A) and drain the oil.
5. Replace the intarder oil filter.



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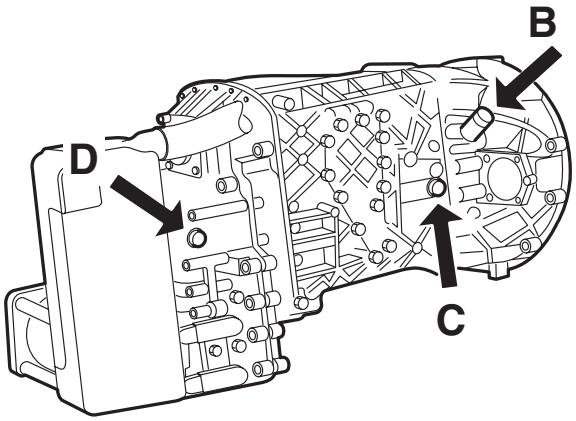
Filling the gearbox

1. Clean the drain plugs and tighten them to the specified torque. See “Technical data”.
2. Top up oil through level check/filler opening (A) until the oil reaches the rim of the filler opening (A).
3. Fit the level check/filler plug (A), tightening it to the specified torque. See “Technical data”.
4. After filling take a short test drive. **Do not** activate the intarder during the test drive.
5. Check the oil level after taking the test drive. The oil level must reach the rim of the level check/filler opening (A).
6. Fit the level check/filler plug (A), tightening it to the specified torque. See “Technical data”.



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CONTENTS

		Page	Date
1.	**GENERAL**	1-1	0111
1.1	System description	1-1	0111
2.	**INSPECTION AND ADJUSTMENT**	2-1	0111
2.1	Inspection, gearbox oil level	2-1	0111
2.2	inspection and adjustment, input shaft bearing axial clearance	2-2	0111
3.	**REMOVAL AND INSTALLATION, GEARBOX**	3-1	0111
3.1	Removal and installation , entire gearbox	3-1	0111
3.2	Removal and installation, drive flange	3-3	0111
3.3	Removal and installation, output shaft oil seal	3-4	0111
3.4	Removal and installation, gearbox front cover sealing ring	3-5	0111
3.5	Removal and installation, selector shaft oil seal	3-6	0111
4.	**DRAINING AND FILLING**	4-1	0111
4.1	Draining and filling, gearbox	4-1	0111

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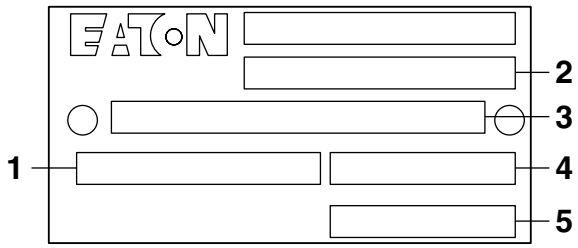
8

1. GENERAL

Gearbox type
Each gearbox has a type plate attached to it, indicating the type of gearbox. This data can also be found on the identity card for the vehicle concerned.

Eaton gearbox type-plate
1. Type of gearbox
2. Specification no. Eaton
3. DAF article Eaton code
4. Serial no. Eaton
5. Production date code

The Eaton specification number is unique to each customer and gives detailed information on the development level of the gearbox. The number must be quoted whenever replacement parts are ordered.



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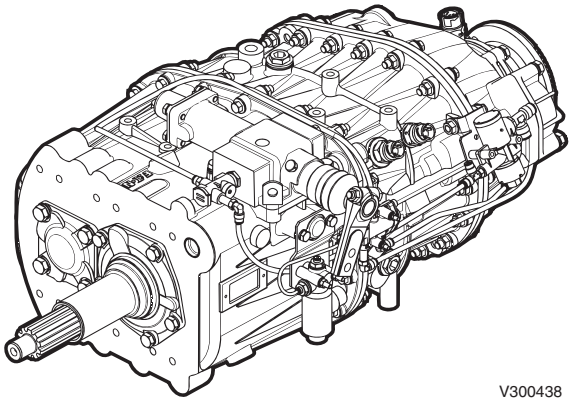
1.1 SYSTEM DESCRIPTION

The gearbox consists of a main gearbox with four synchronised forward gears, a non-synchronised crawler gear, and one non-synchronised reverse gear. Between the main gearbox and the output shaft, there is a set of planetary range gears with pneumatic synchronisation.

In the low range (planetary system engaged), the crawler gear and gears 1, 2, 3 and 4 can be engaged.
In the high range (planetary system disengaged), gears 5, 6, 7 and 8 can be engaged.

The switching system is in a “single-H” pattern. Use of the “single-H” system means that the low or high range must be selected by means of a button on the ball of the gear lever prior to engaging gear. The group is changed as soon as the selector shaft passes through the neutral position.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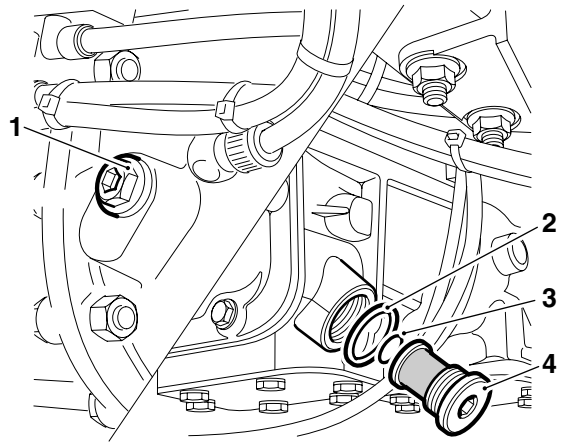
2. INSPECTION AND ADJUSTMENT

2.1 INSPECTION, GEARBOX OIL LEVEL

To prevent skin injury, avoid unnecessary contact with the drained oil.

1. Position the vehicle on a level surface.
2. Wait for some minutes for the oil to flow back.
3. Remove the level check/filler plug (1) and check the oil level.
4. The oil level must reach the rim of the level check/filler opening (1).
5. After checking the oil level, tighten the level check plug to the specified torque. See “Technical data”.



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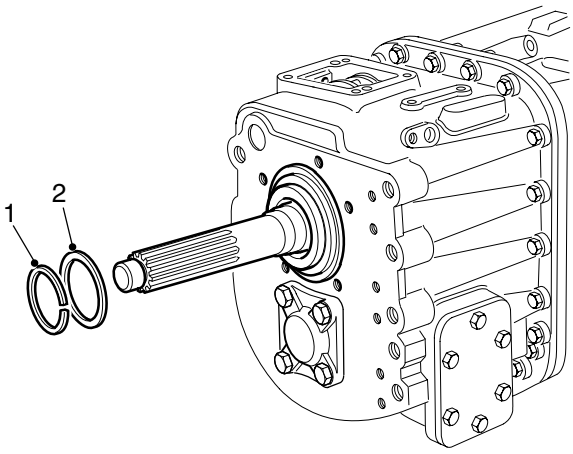
2.2 INSPECTION AND ADJUSTMENT, INPUT SHAFT BEARING AXIAL CLEARANCE

Inspection, input shaft bearing axial play

1. Remove the gearbox. See “Removal and installation”.
2. Remove the gearbox front cover from the input shaft. See “Removal and installation”.
3. Check whether the circlip (1) is flush in the groove. Check at various places around the shaft.
4. If necessary, adjust the axial play by means of a thicker or thinner adjusting ring (2).

Adjustment, input shaft bearing axial play

1. Remove the circlip (1) of the input shaft bearing.
2. Remove the adjusting ring (2).
3. Place an adjusting ring (2) of the correct thickness between the input shaft bearing and the circlip. See “Technical data”.
4. Fit the circlip (1) without any play into the groove. Check at various places around the shaft.
5. Fit a new gasket to the gearbox front cover and install the gearbox front cover. See “Removal and installation”.
6. Fit the gearbox. See “Removal and installation”.



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3. REMOVAL AND INSTALLATION, GEARBOX

3.1 REMOVAL AND INSTALLATION , ENTIRE GEARBOX

Removing the entire gearbox

1. Make sure there are no loose items in the cab. Tilt the cab.
2. Disconnect the battery negative terminal.
3. Remove the attachment bolts of the prop shaft flange and remove the prop shaft.
4. Remove the attachment bolt from the exhaust bracket on the gearbox.
5. Remove the clamping straps of the intermediate pipe and remove the same.
6. Remove the end of the exhaust by removing the clamping strap and the attachment bolt of the rubber suspension point at the end of the exhaust.
7. Remove the attachment bolts from the clutch cylinder and remove the clutch cylinder.
8. Mark the electrical connectors and disconnect them.
9. Remove the compressor pipe bracket.
10. Remove the shift control.
11. Mark the various air pipes and remove them.
12. Support the gearbox and remove the attachment bolts around it.
13. Use the jack to pull the gearbox from the engine and remove the gearbox.

Installing the gearbox

1. Engage the highest gear in order to align the keys of the input shaft with the clutch plate.
2. Fit the gearbox to the engine. If necessary, rotate the drive flange in order to align the keys.
3. Fit the gearbox attachment bolts all around and tighten them to the specified torque. See “Technical data”.
4. Fit the shift control.
   Tighten the nuts to the specified torque. See “Technical data”.
5. Fit the exhaust intermediate pipe.
6. Fit the exhaust end pipe.
7. Install the compressor pipe bracket.
8. Install the electrical connectors to the gearbox.
9. Fit the clutch cylinder and tighten the attachment bolts to the specified torque. See “Technical data”.
10. Fit the air pipes.
11. Fit the prop shaft flange to the gearbox. Tighten the attachment bolts to the specified torque. See “Technical data”.
12. Connect the negative lead to the battery terminal.
13. Inspect the shift control.
14. Check the oil level after the gearbox has been installed.
15. If a gearbox of a different type is mounted, or a gearbox with a different reduction, this should be reported.
    If the correct data are present, they can be input into the VIC using DAVIE XD.

3.2 REMOVAL AND INSTALLATION, DRIVE FLANGE

Removing the drive flange

1. Place a reference mark on the prop shaft in relation to the flange.
2. Remove the bolts that attach the prop shaft to the flange.
3. Support the prop shaft from a suitable location on the chassis.
4. Support the prop shaft from a suitable location on the chassis.
5. Fit special tool (DAF No. 0484977) to hold the drive flange in position. Remove the lock nut and ring.
6. Remove the flange with a suitable puller.

   Note:
   In order to prevent the synchroniser for the high/low transmission ratios from coming loose, the output shaft must not slide out of the bearing.

Installing the drive flange

1. Place the flange on the output shaft.
2. Place a shim between the flange and the lock nut and turn the flange in the oil seal. Remove the lock nut and shim.
3. Fit special tool (DAF No. 0484977) to the flange. Fit a new lock nut. Tighten the lock nut to the specified torque. See “Technical data”.
4. Align the markings. Fit the prop shaft to the flange. Tighten the attachment bolts to the specified torque. See “Technical data”.

3.3 REMOVAL AND INSTALLATION, OUTPUT SHAFT OIL SEAL

Removing the output shaft oil seal

1. Remove the drive flange.
2. Remove the attachment bolts from the oil seal housing. Remove the oil seal housing. Remove the oil seal.
3. Clean the contact surfaces of the oil seal and the seal housing.

Installing the output shaft oil seal

1. Press the oil seal into its housing with special tool (DAF No. 1329358).
2. Apply sealant to the contact surface of the oil seal housing.
3. Fit the sealing housing and tighten the bolts to the specified torque. See “Technical data”.
4. Apply grease to the lip of the oil seal.
5. Fit the drive flange.
6. If necessary, top up the gearbox. See “Technical data”.

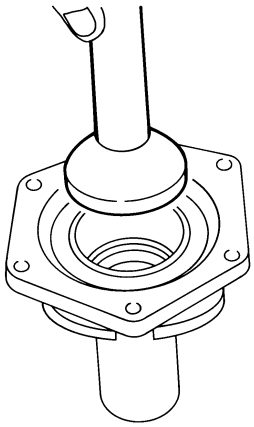
3.4 REMOVAL AND INSTALLATION, GEARBOX FRONT COVER SEALING RING

Removing the gearbox front cover oil seal

1. Remove the gearbox.
2. Disconnect the clutch housing and the clutch release assembly.
3. Remove the attachment bolts from the gearbox front cover. Remove the gearbox front cover. Clean the contact surfaces of the gearbox front cover and the gearbox housing.
4. Remove the oil seal from the gearbox front cover.

Installing the gearbox front cover oil seal

1. Fit the oil seal in the gearbox front cover using special tool (DAF No. 1329354).
2. Apply sealant to the contact surface of the gearbox front cover. Fit the gearbox front cover. Tighten the attachment bolts to the specified torque. See “Technical data”.
3. Fit the clutch housing and clutch release assembly to the gearbox. Tighten the attachment bolts to the specified torque. See “Technical data”.
4. Fit the gearbox.



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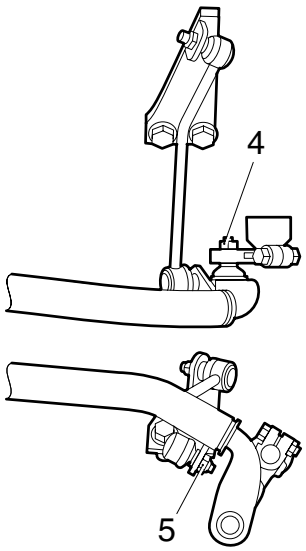
3.5 REMOVAL AND INSTALLATION, SELECTOR SHAFT OIL SEAL

Removing the selector shaft oil seal

1. Remove the nut (4) of the ball joint of the control rod on the selector shaft lever and the nut (5) of the torque rod.
   Hang the control rod on the chassis.

2. Remove the selector shaft lever locking bolt. Then remove the selector shaft lever (1) together with the rubber sleeve (2).



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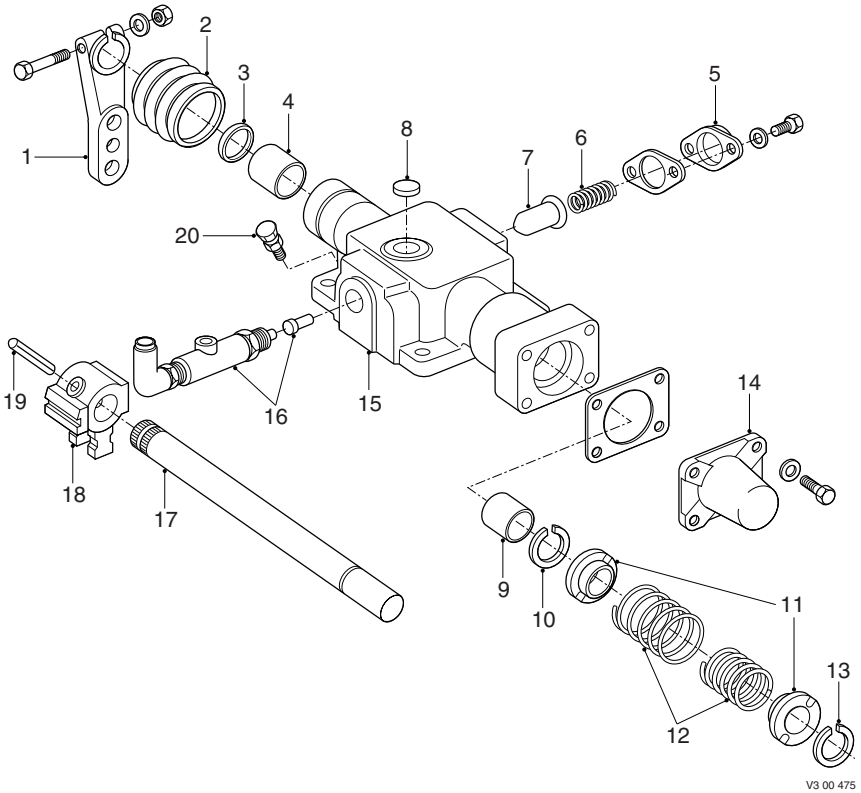

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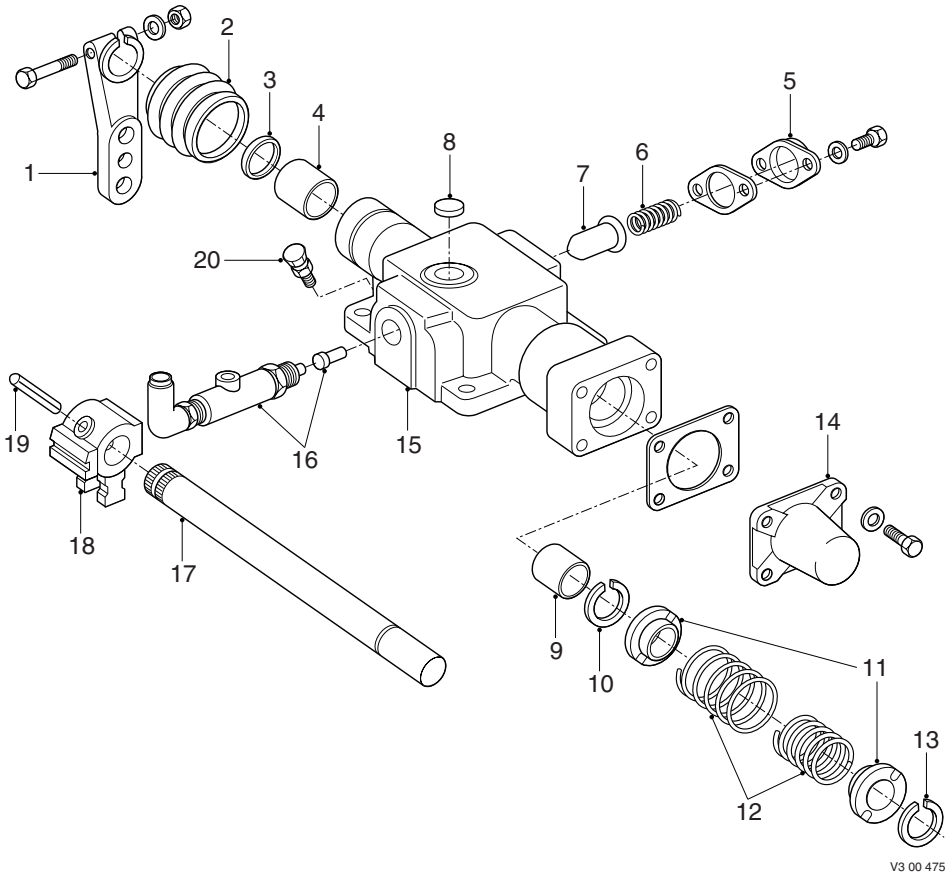
3. Drain the air reservoirs and remove the air connection from the selector shaft housing.
4. Remove the bleed control valve and pin (16).
5. Remove the attachment bolts from the selector shaft housing (15) and remove the housing.
6. Place the housing in a soft-jawed vice.
7. Remove the retaining cover (5) and pull out the retaining spring (6) and pin (7).
8. Remove the bleeder (20).
9. Remove the end cover (14) and remove the circlip (13).
10. Remove the spring holders (11), the springs (12) and the circlip (10).
11. Turn the selector shaft housing over and drive the plug (8) out of the housing.
12. Turn the selector shaft housing over and drive the plug, pin (19) out of the selector finger (18) and selector shaft housing (17) via the opening.
13. Remove the selector finger (18) and the selector shaft (17).
14. Remove the oil seal (3) from the selector shaft housing. If necessary, the selector shaft bearing bushes (4) and (9) can now also be removed using a suitable puller.

Installing the selector shaft oil seal



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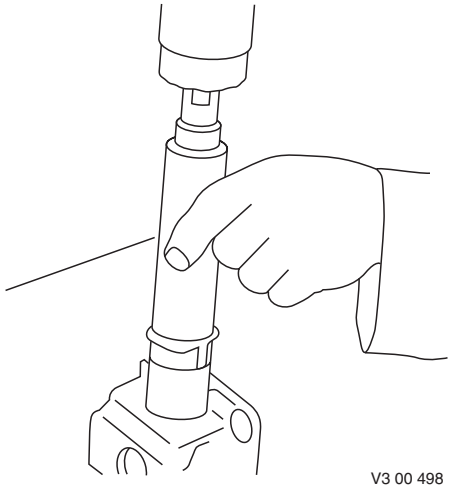
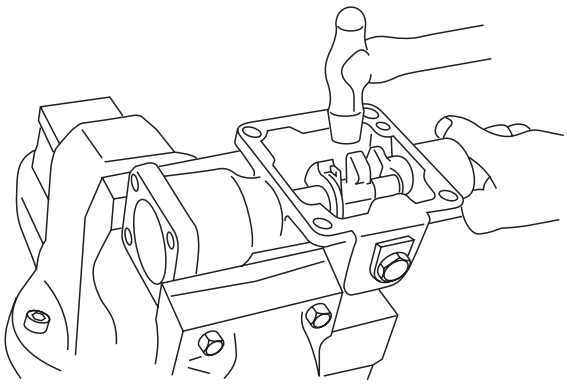
1. Fit a new oil seal ring and, if necessary, new bushes (4) and (9) using special tool (DAF No. 1329352).
2. Place the selector finger (18) in the selector shaft housing (15) with the long groove and the hole for the pin (19) pointing towards the rear.
3. Fit the selector shaft (17) into the selector shaft housing,



4. Fit a new pin (19).
   Make sure that the holes in the selector finger and the selector shaft are aligned.
5. Fit the circlip (10) and a spring holder (11) onto the selector shaft.
6. Fit the springs (12), a spring holder (11) and the circlip (13) onto the selector shaft.
7. Put a new gasket in the end cover (14) and attach the cover. Tighten the attachment bolts to the specified torque. See “Technical data”.
8. Fit the retaining pin (7) and put a new gasket in the retaining cover (5) before fitting that as well. Tighten the attachment bolts to the specified torque. See “Technical data”.
9. Fit the rubber sleeve (2).
10. Install the bleeder (20) and tighten to the specified torque. See “Technical data”.
11. Fit the bleed control valve and pin (16) and tighten to the specified torque. See “Technical data”.
12. Fasten the selector shaft housing to the gearbox using the specified locking compound.
13. Tighten the attachment bolts to the specified torque. See “Technical data”.
14. Adjust the gearbox control and fit the selector shaft lever. See “Inspection and adjustment”.



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4. DRAINING AND FILLING

4.1 DRAINING AND FILLING, GEARBOX

To prevent skin injury, avoid unnecessary contact with the drained oil.

Draining, gearbox

1. Place the vehicle on a level surface.

   Note:
   Drain the gearbox at operating temperature.

2. Remove the combined drain plug/oil strainer (4) and level check/filler plug (1) and drain the oil.

3. Clean the oil strainer (4) in a suitable solvent and dry the oil strainer thoroughly.

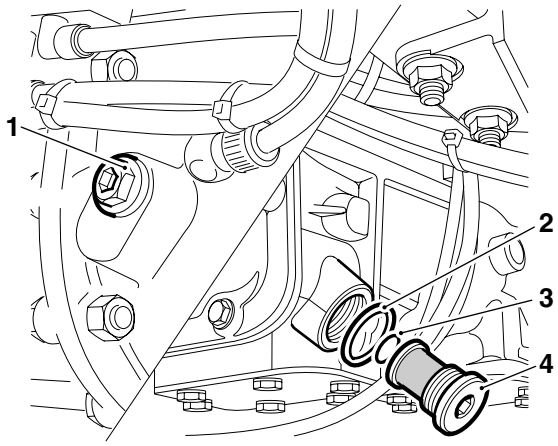
Filling, gearbox

1. Check and replace the O-ring (3) and the sealing ring (2), if necessary.

2. Tighten the combined drain plug/oil strainer to the specified torque. See “Technical data”.

3. Fill the oil through level check/filler opening (1) until the oil reaches the rim of the level check/filler opening.

4. Fit the level check/filler plug, tightening it to the specified torque. See “Technical data”.



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CONTENTS

		Page	Date
1.	**GENERAL**	1-1	200337
1.1	System description	1-2	200337
2.	**DESCRIPTION OF COMPONENTS**	2-1	200337
2.1	Automatic gearbox selector keypad	2-1	200337
3.	**INSPECTION AND ADJUSTMENT**	3-1	200337
3.1	Inspection, oil level	3-1	200337
4.	**REMOVAL AND INSTALLATION**	4-1	200337
4.1	Removal and installation, gearbox assembly	4-1	200337
4.2	Removal and installation, output shaft oil seal	4-2	200337
4.3	Removal and installation, oil filters	4-5	200337
5.	**DRAINING AND FILLING**	5-1	200337
5.1	Draining and filling, gearbox	5-1	200337

9

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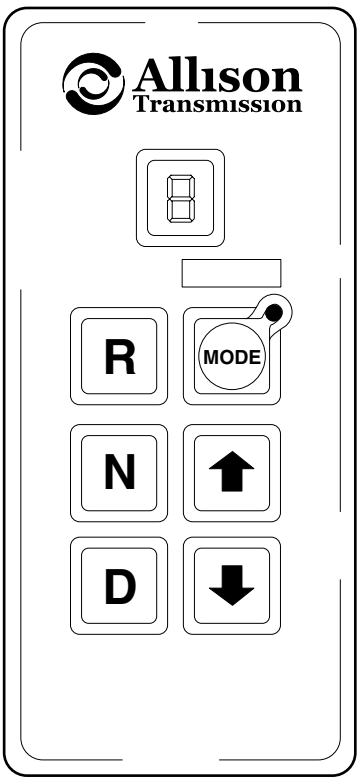
1. GENERAL

Allison transmission, used in the *CF*65/75-series, is electronically controlled and has its own diagnostic system that saves any faults in the memory of the ECU (Electronic Control Unit). The faults can be read at a later date. The system is operated and the faults are read via the selector keypad.
The selector is equipped with a display and is located immediately next to the driver's seat.
The selector replaces the gear lever of manually operated gearboxes.

Type designation:
Example MD3060 P
MD Medium Duty
3 Gearbox series
0 Transmission ratios occurring in quick succession
6 Number of possible gears
0 Modification number
P PTO version



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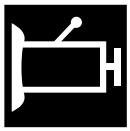
1.1 SYSTEM DESCRIPTION

“Gearbox” warning symbol
When the vehicle ignition is switched on, the “gearbox” warning symbol will not appear on the DIP display.



If the gearbox symbol appears in the main display, it indicates a fault in the gearbox (shifting), **or** that the gearbox oil temperature is too high. The “gearbox” warning symbol in the DIP will then be displayed in yellow. The selector keypad LED will also flash three times. The accompanying fault code can be read in the selector reading mode (display).

The ECU will block the functions of the selector and the gearbox will shift to a “safe gear” for the gearbox. It is important to drive the vehicle to a safe place as soon as possible and switch the ignition off. It will no longer be possible to shift the gearbox to neutral. The ECU will prevent this.

After approximately 30 seconds, try starting the engine again and engaging gear. If the error is one whereby the gearbox must under no circumstances be shifted, the ECU will no longer shift the gearbox.
The warning symbol on the DIP display will then appear in red. The “STOP” warning indicator will also light up.
Driving is therefore no longer possible!

If the error is one whereby the gearbox may still be shifted, the warning on the main display will disappear. The ECU will have recorded the error as an inactive error.
It is now possible to drive the vehicle again, even though the error will re-occur after a while. In this situation, however, it is no longer possible to shift gear.

9

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Gearbox oil temperature
If when driving the gearbox warning lamp lights up in the main display, this may mean that the gearbox oil has reached the maximum temperature of 121°C.
In this situation, the ECU limits the gearbox to shifting in the first four gears.
It is important to drive to a safe place as soon as possible and let the engine idle in neutral at an increased idling speed.
By this means, the engine cooling system can try to cool the gearbox oil.
If after approximately two minutes the warning lamp has not gone out, the engine must be turned off and the nearest DAF dealer contacted.

Use of the engine brake
When the engine brake is operated in third or higher gear, the ECU will change down to second gear as soon as the engine speed permits, to get the maximum braking effect from the engine brake.
On the selector display, the second gear selected by the ECU is displayed.

Towing the vehicle
To tow the vehicle, the prop shaft must be detached at the rear axle.
It is also possible to remove the axle shafts. As oil can be lost in this process, this must be avoided as much as possible owing to environmental concerns.

Towing the vehicle without taking the above into consideration may lead to serious damage to the gearbox.

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2. DESCRIPTION OF COMPONENTS

2.1 AUTOMATIC GEARBOX SELECTOR KEYPAD

The selector has the following functions:
- activating and deactivating the gearbox.
- choosing a shift program
- reading the oil level
- reading and deleting fault codes

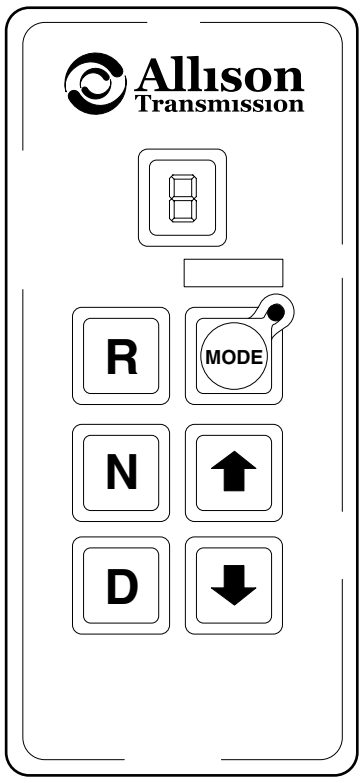
The selector has the following six keys:

Neutral	Neutral position	Display shows “N”
Drive	Automatic drive	Highest gear
Reverse	Reverse	Display shows “R”
MODE	Shift program selection	Normal or economy (LED on) program
↑	Change up	Display shows the gear selected
↓	Change down	Display shows the gear selected

Neutral position
No gears are activated in the “N” position. The vehicle is **not** locked in this position and can thus roll.
Use the parking brake to lock the vehicle.
“**N**” appears on the display.

Automatic drive
If the “D” position is selected, the vehicle will immediately begin to move (if the brake system is at pressure and the vehicle is not on the parking brake). It is therefore advisable to depress the brake pedal before selecting position “D”. In this position the gearbox can automatically change up to the highest gear. The highest gear that the gearbox can change up to is shown on the display.

Reverse
Even if the “R” position is chosen the vehicle will immediately be set in motion. So again, first depress the brake pedal and then select the “R” position. “**R**” appears on the display.



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Shift program selection
By pressing the “MODE” key briefly once, another shift program can be selected when stationary, but also when driving. Two selections are possible:

Normal program:
This program is chosen automatically when the vehicle ignition has been switched off. No message is displayed. This program allows the gearbox to change gear if necessary, so that driving at higher engine speeds is possible. This can be desirable on unpaved terrain.

Economy program:
The LED lights up on the selector display. This program will, in general, change gear at somewhat lower engine speeds. This results in more economical fuel consumption.

↓ **Change down**
After the “D” key is selected and when the vehicle is driving, this key can be used to keep the gearbox in a lower gear. The selected gear can be seen in the display. The gearbox will not change up further until the “↑” or “D” key is pressed. The number of gears that can be used will appear in the display.

↑ **Change up**
This key is used to make the gearbox change up to a higher gear. However, this is only possible after previously selecting to stay in a low gear.

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Faults
If the oil level indicator cannot give the correct oil level, one of the following codes will appear in the display.

OL - 50	Engine speed too low
OL - 59	Engine speed too high
OL - 65	Gearbox is not in neutral
OL - 70	Gearbox oil temperature too low
OL - 79	Gearbox oil temperature too high
OL - 89	Output shaft is not stationary (handbrake)
OL - 95	Oil level indicator is defective

The oil level reading function can be left by pressing “D”, “N” or “R”.

Note: the function cannot be left by pressing the arrow keys again, as this prompts the diagnostic code reading function. All diagnostic codes are preceded by the letter D followed by a figure between 1 and 5. In this function, important fault codes could be deleted from the memory by an unqualified user.

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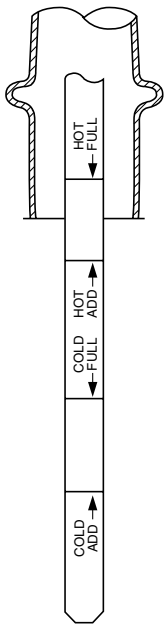
3. INSPECTION AND ADJUSTMENT

3.1 INSPECTION, OIL LEVEL

Inspection, cold oil level

1. Place the vehicle on a level surface.
2. Make sure that the gearbox is in neutral and allow the engine to run for several minutes.
3. Operate the service brake, put the gearbox in **D**, then in **N,** and finally put the gearbox in **R**. The purpose of this is to fill the hydraulic system.
4. Switch the gearbox to the park position and release the service brake.
5. Remove the dipstick when the engine is idling and wipe it clean with a lint-free cloth.

   Note:
   To take the dipstick out of the holder, the sealing cap must be held tightly and the dipstick turned anti-clockwise.
6. Put the dipstick back.
7. Remove the dipstick and check the oil level. The oil level must be between the “Cold add” and the “Cold full” marks.
8. Clean the dipstick with a lint-free cloth and put it back.
9. Remove the dipstick and check the oil level.
10. Oil needs to be added when the oil level is below the “Cold add” mark.
11. Now check the oil level in the gearbox at operating temperature.



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Inspection, hot oil level

1. Bring the gearbox to operating temperature (approx. 71°C - 93°C).
2. Remove the dipstick when the engine is idling and wipe it clean with a lint-free cloth.

   Note:
   To take the dipstick out of the holder, the sealing cap must be held tightly and the dipstick turned anti-clockwise.
3. Put the dipstick back.
4. Remove the dipstick and check the oil level.
5. The oil level must be between the “Hot add” and the “Hot full” marks.
6. Clean the dipstick with a lint-free cloth and put it back.
7. Remove the dipstick and check the oil level again.
8. Oil needs to be added when the oil level is below the “Hot add” mark.
9. Oil needs to be drained when the oil level is above the “Hot full” mark.

   Note:
   The oil level must be checked at least twice. When there are differences between the measurements, check the bleeder for clogging.

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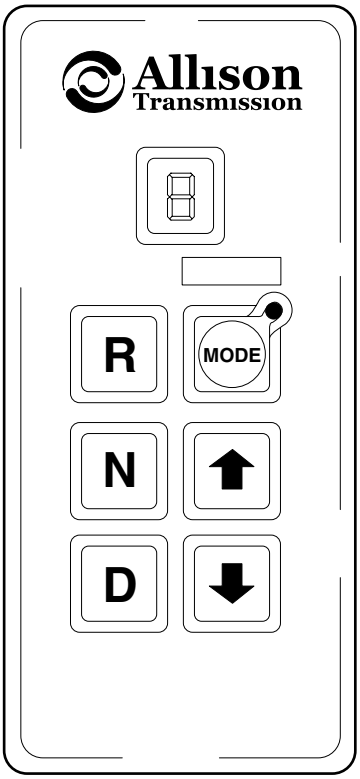
Checking the oil level using the selector keypad

1. Apply parking brake, put the gearbox in the neutral position and bring the gearbox to operating temperature (approx. 71°C - 93°C).
2. Run the engine at idling speed for 2 minutes.
3. Press both arrow keys on the selector keypad simultaneously. The display now indicates **O** and **L**.

   Note:
   O and **L** stand for **O**il **L**evel.
4. If the oil level is correct, **O** - **K** will appear in the display. When the oil level is too high, this is indicated by **HI** followed by the number of litres in excess. When the oil level is too low, this is indicated by **LO** followed by the number of litres lacking. For example:
   LO-02 means add two litres.
   HI-03 means drain three litres.



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4. REMOVAL AND INSTALLATION

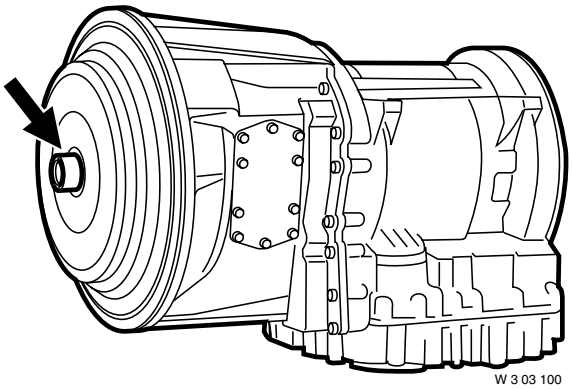
4.1 REMOVAL AND INSTALLATION, GEARBOX ASSEMBLY

Removing the gearbox assembly

1. **Note:**
   Before the gearbox can be removed, the gearbox oil must be drained.
2. If necessary, remove the oil filler pipe to avoid damage.
3. Plug the external oil pipes after removing and/or detaching them to prevent dirt entering the oil system.
4. Disconnect the gearbox cable harness connectors and secure the cable harness. Plug the openings.
5. Remove the prop shaft.
6. See what is best for gearboxes with PTO: remove the PTO from the gearbox, disconnect the hydraulic pipes from the pump or remove the prop shaft, if fitted.
7. Remove the gearbox from the engine.

Installing the gearbox assembly

1. Apply grease sparingly to the nose of the torque converter to prevent noise after fitting. See “Technical data”.
2. Install the PTO.
3. If necessary, fit the hydraulic pipes and/or prop shaft.
4. Attach the prop shaft.
5. Connect the cable harness connectors.
6. Fit the external oil pipes.
7. If necessary, fit the oil filler pipe.
8. Fill the gearbox with oil and check the oil level.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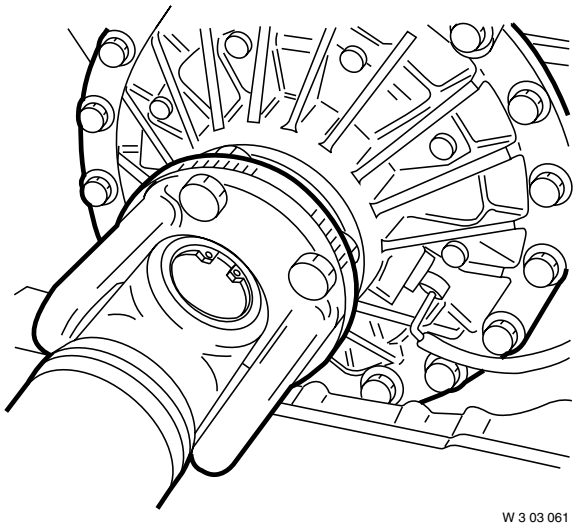
4.2 REMOVAL AND INSTALLATION, OUTPUT SHAFT OIL SEAL

Removing the output shaft oil seal

1. Remove the prop shaft and secure it so that it does not interfere with further operations.



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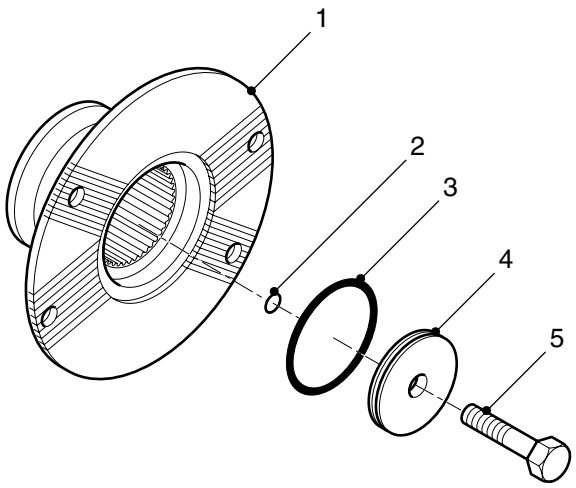
2. Unscrew the attachment bolt (5) of the flange without removing it from the locking plate.



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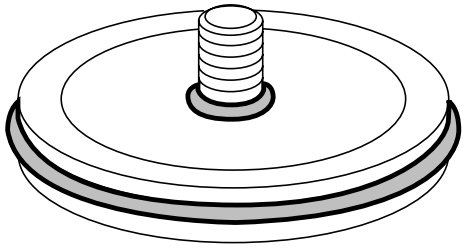
3. Remove the bolt and locking plate from the flange.
   Pay attention to the sealing rings on the outer circumference and on the inside of the locking plate.



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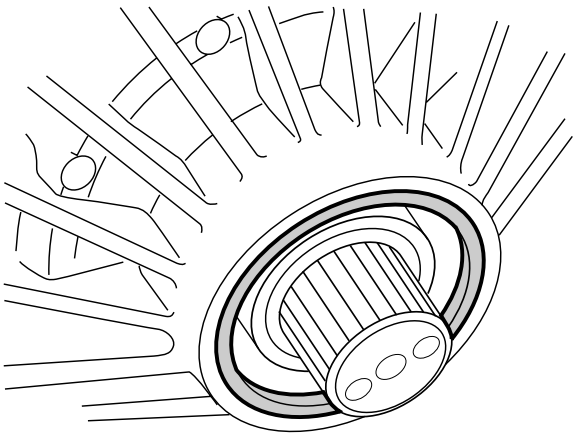
4. Slide the flange from the output shaft or, if necessary, use a tripod puller to pull the flange from the shaft.



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5. Drill two holes into the external cover of the oil seal and turn the special tool (DAF No. 0484899) into the oil seal. Pull the oil seal from the gearbox housing using the special tool (DAF No. 0694928).

Installing the output shaft oil seal

1. Apply a small amount of liquid gasket to the outside of oil seals fitted with a steel cover. Apply green soap sparingly to the outside of oil seals fitted with a rubber cover.
2. Fit the oil seal in the gearbox housing using the special tool (DAF No. 1240037).
3. Apply grease sparingly to the oil seal lips and slide the flange over the output shaft until it abuts.

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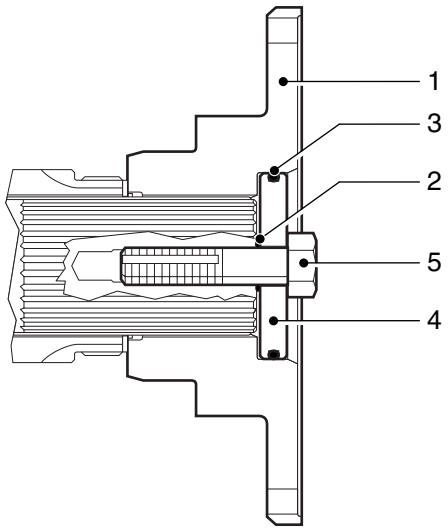
4. Fit new sealing rings (2, 3) to the locking plate and fit the locking plate with the attachment bolt to the flange (apply grease sparingly to the sealing rings).

   Note:
   For the new gearboxes the attachment bolts are no longer locked with a locking plate, but with self-locking screw thread in the output shaft.

5. Hold the prop shaft flange in place with the special tool (DAF No. 0484977).

6. Tighten the attachment bolt (5) to the specified torque. See “Technical data”.

If the locking plate is not tightened to the specified torque, there is a risk of the locking plate getting bent during fitting, which could lead to serious oil leakage.



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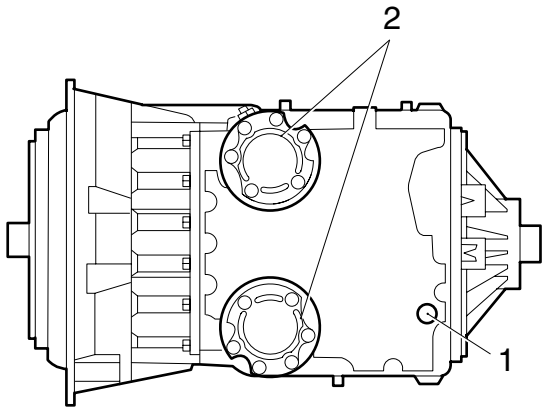
4.3 REMOVAL AND INSTALLATION, OIL FILTERS

Removing the oil filters

1. Remove the attachment bolts from the filter covers (2) and take the filter covers off. Collect any oil flowing out of the system.
2. Remove the oil filters from the oil sump.
3. Remove the various O-rings from the filter covers.
4. If a gasket has been used, remove the gasket remnants from the filter covers and the contact surfaces.



Installing the oil filters

1. Lightly lubricate the new O-rings with clean gearbox oil and fit the various O-rings on the filter covers.

   Note:
   Compare the new O-rings with the old O-rings to ensure that the correct O-rings are being used.
2. If a gasket has been used, fit a new gasket on the filter cover.
3. Lightly lubricate the rubber inner ring of the oil filters with clean gearbox oil and fit the oil filters on the filter covers.
4. Carefully position the filter covers and oil filters on the gearbox and tighten the attachment bolts to the specified torque. See “Technical data”.
5. Check the oil level. See “Inspection and adjustment”.

9

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5. DRAINING AND FILLING

5.1 DRAINING AND FILLING, GEARBOX

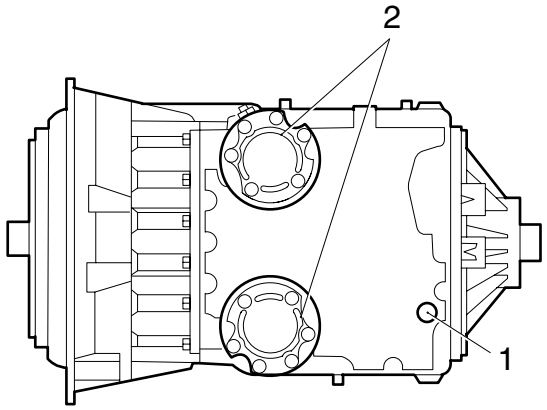
To prevent skin injury, avoid unnecessary contact with the drained oil.

Draining the gearbox

1. Bring the gearbox to operating temperature (approx. 71°C - 93°C) before the oil is drained, so that the oil can be drained more quickly and more completely.
2. Place the vehicle on a level surface.
3. Remove the drain plug (1) from the gearbox oil sump.
4. Remove the oil filters (2). See “Removal and installation”.

Filling the gearbox

1. Clean the drain plug (1) and, fitted with a new sealing ring, tighten it to the specified torque. See “Technical data”.
2. Install the oil filters (2). See “Removal and installation”.
3. Fill the gearbox through the dipstick holder with the specified oil quantity. See “Technical data”.



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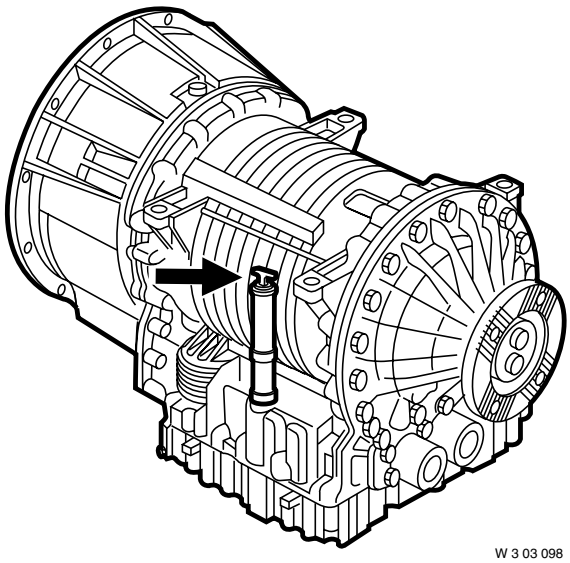
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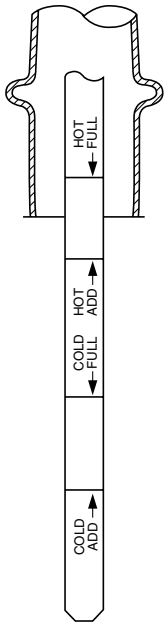
4. Check whether the oil level is at the “Cold full” mark.

   Note:
   To take the dipstick out of the holder, the sealing cap must be held tightly and the dipstick turned anti-clockwise.

5. Use the selector keypad to check the oil level. See “Inspection and adjustment”.



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CONTENTS

		Page	Date
1.	**SAFETY INSTRUCTIONS**	1-1	200337
1.1	Safety instructions	1-1	200337
2.	**GENERAL**	2-1	200337
2.1	System description, clutch	2-1	200337
2.2	System description of clutch protection	2-5	200337
2.3	Overview drawing, main cylinder	2-6	200337
2.4	Overview drawing, CF75/85 clutch servo	2-7	200337
2.5	Overview drawing, CF65 clutch servo	2-8	200337
2.6	Overview drawing, AS Tronic clutch unit	2-9	200337
2.7	Overview drawing, automatically adjusting clutch release assembly	2-10	200337
2.8	Overview drawing, clutch lever attachment to gearbox	2-11	200337
2.9	Overview drawing, clutch lever attachment to clutch housing	2-12	200337
3.	**DESCRIPTION OF COMPONENTS**	3-1	200337
3.1	Main cylinder	3-1	200337
3.2	CF75/85 clutch servo	3-2	200337
3.3	CF65 clutch servo	3-4	200337
3.4	AS Tronic clutch unit	3-6	200337
3.5	Automatically adjusting clutch release assembly	3-8	200337
3.6	CF75/85 clutch wear indicator	3-12	200337
3.7	CF65 clutch wear indicator	3-12	200337
3.8	Thrust bearing	3-13	200337
4.	**INSPECTION AND ADJUSTMENT**	4-1	200337
4.1	Inspection and adjustment, clutch pedal	4-1	200337
4.2	Inspection, clutch servo	4-3	200337
4.3	Inspection, clutch fluid level	4-5	200337
5.	**REMOVAL AND INSTALLATION**	5-1	200337
5.1	Removal and installation, clutch servo	5-1	200337
5.2	Removal and installation, AS Tronic clutch unit	5-3	200337
5.3	Removal and installation, pull-type clutch thrust bearing	5-4	200337
5.4	Removal and installation, push-type clutch thrust bearing	5-6	200337
5.5	Removal and installation, pull-type clutch lever	5-7	200337
5.6	Removal and installation, push-type clutch lever	5-8	200337
5.7	Removal and installation, clutch release assembly/clutch plate	5-9	200337
5.8	Removal and installation, automatically adjusting clutch release assembly/ clutch plate	5-11	200337
5.9	Removal and installation, pilot bearing	5-15	200337
5.10	Removal and installation, main cylinder	5-16	200337
6.	**DRAINING AND FILLING**	6-1	200337
6.1	Draining and filling, clutch system	6-1	200337
6.2	Bleeding the clutch system	6-2	200337
6.3	Bleeding AS Tronic clutch unit	6-4	200337

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1. SAFETY INSTRUCTIONS

1.1 SAFETY INSTRUCTIONS

Hydraulic fluid is toxic and can have a damaging effect on your health. Direct or indirect physical contact should therefore be avoided.

As hydraulic fluid is also a corrosive fluid, it may damage the paintwork of the vehicle. Avoid any contact between hydraulic fluid and paintwork.

Always use new and clean hydraulic fluid which has been kept in a sealed container that meets the specifications.
Hydraulic fluid which has absorbed water (from the ambient air) may have an adverse effect on the operation of the clutch system.
Avoid any contact with mineral oil. Even one drop of mineral oil in the system will damage the seals.

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2. GENERAL

2.1 SYSTEM DESCRIPTION, CLUTCH

The clutch is a single dry-plate clutch, which is hydraulically operated and pneumatically assisted.

The clutch consists of:
- flywheel
- clutch plate
- clutch release assembly

By clamping the clutch plate between the flywheel and the clutch release assembly, a torque can be transferred (by means of friction). The extent of the torque that must be transferred by the clutch is determined by the maximum engine torque multiplied by the safety factor (usually 1.3).

To clamp the clutch plate, a diaphragm spring is used in the clutch release assembly.

A diaphragm spring constitutes a simple, strong and cost-effective construction.
Another advantage of the diaphragm spring is that the pressure exerted on a new clutch plate almost equals the pressure exerted on a worn clutch plate.
The operation of the diaphragm spring (the coupling and uncoupling of the clutch plate) can take place in:
- a push-type clutch
- a pull-type clutch

Push-type clutch

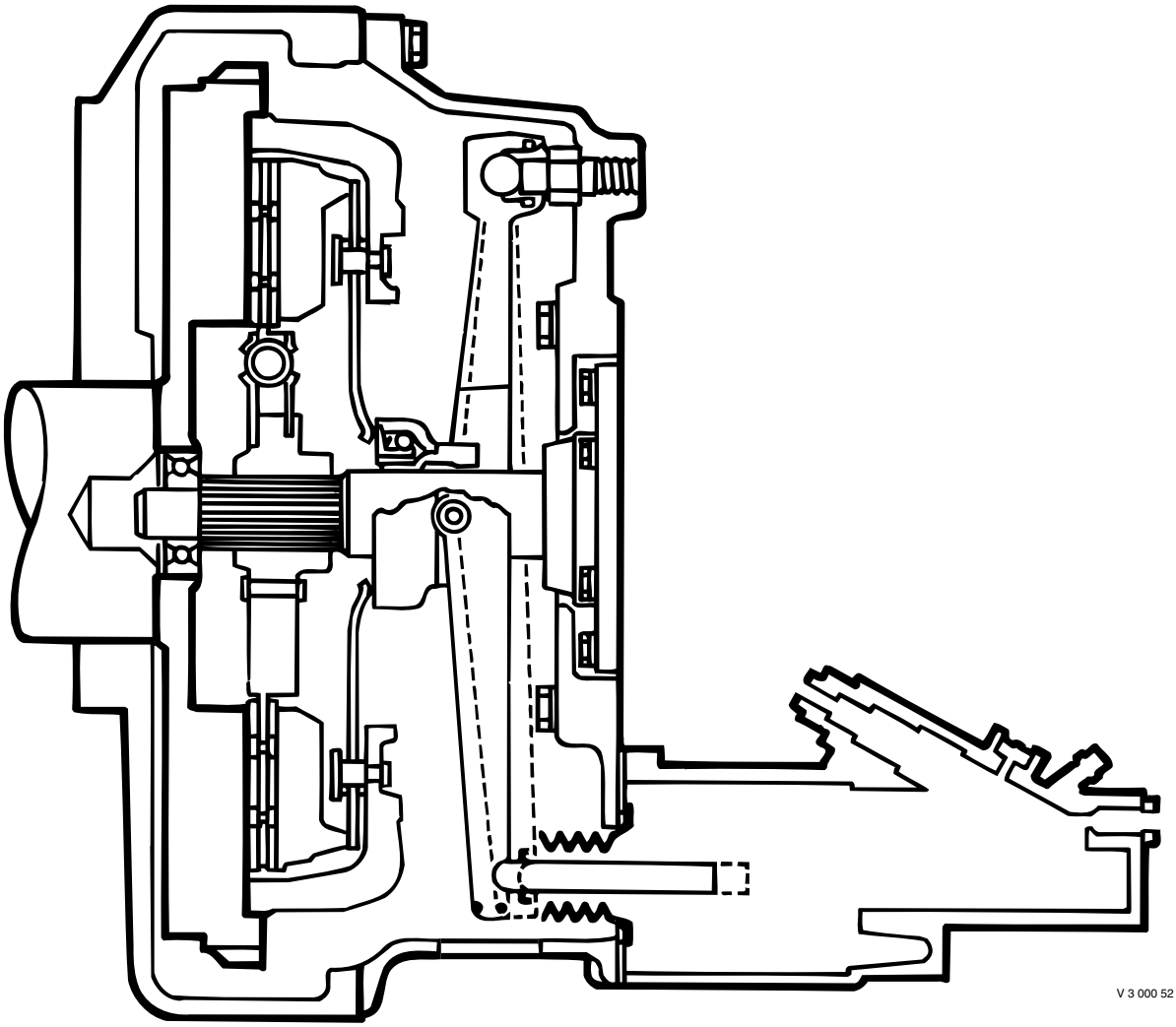

Fig. 1

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Pull-type clutch

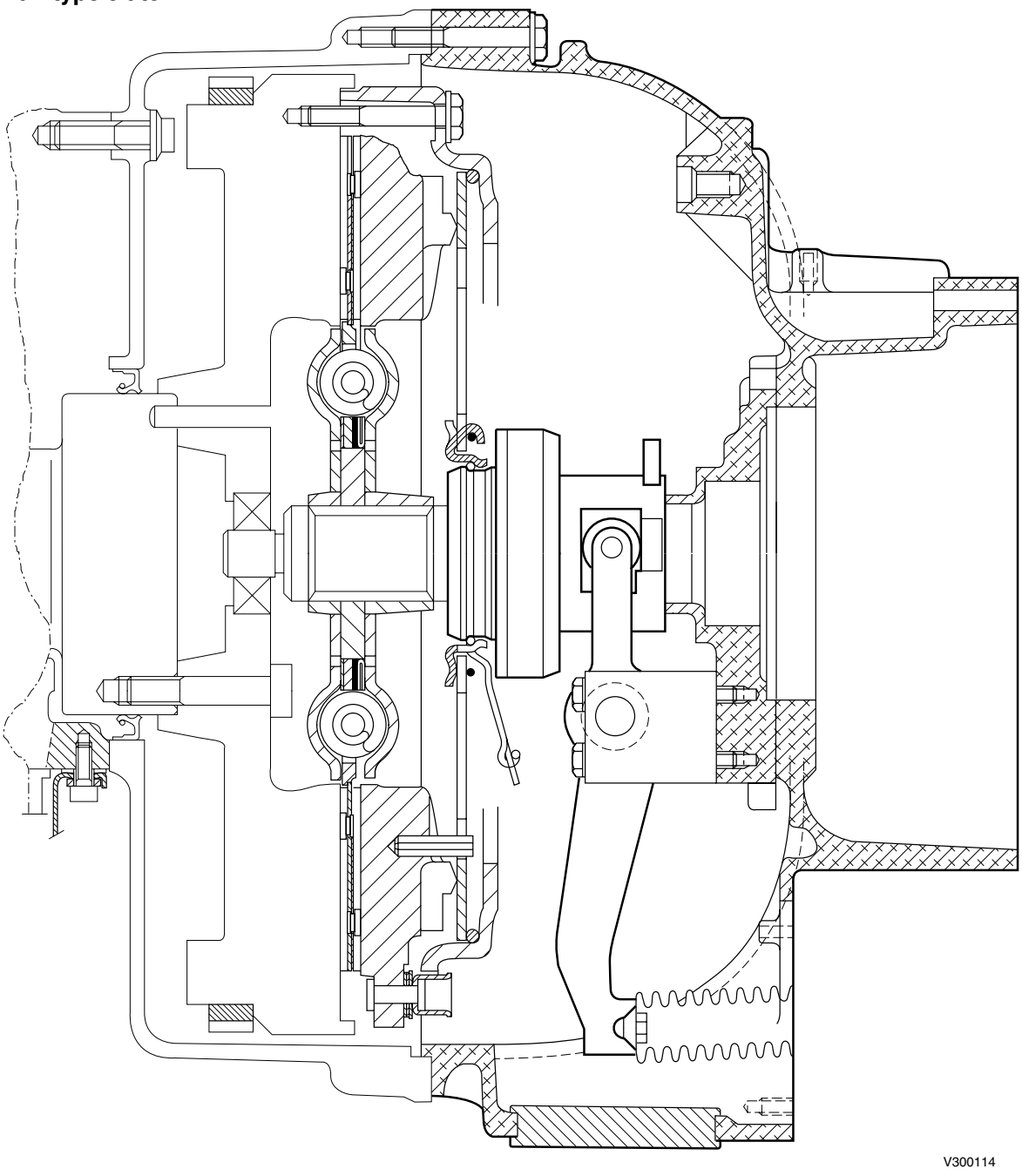
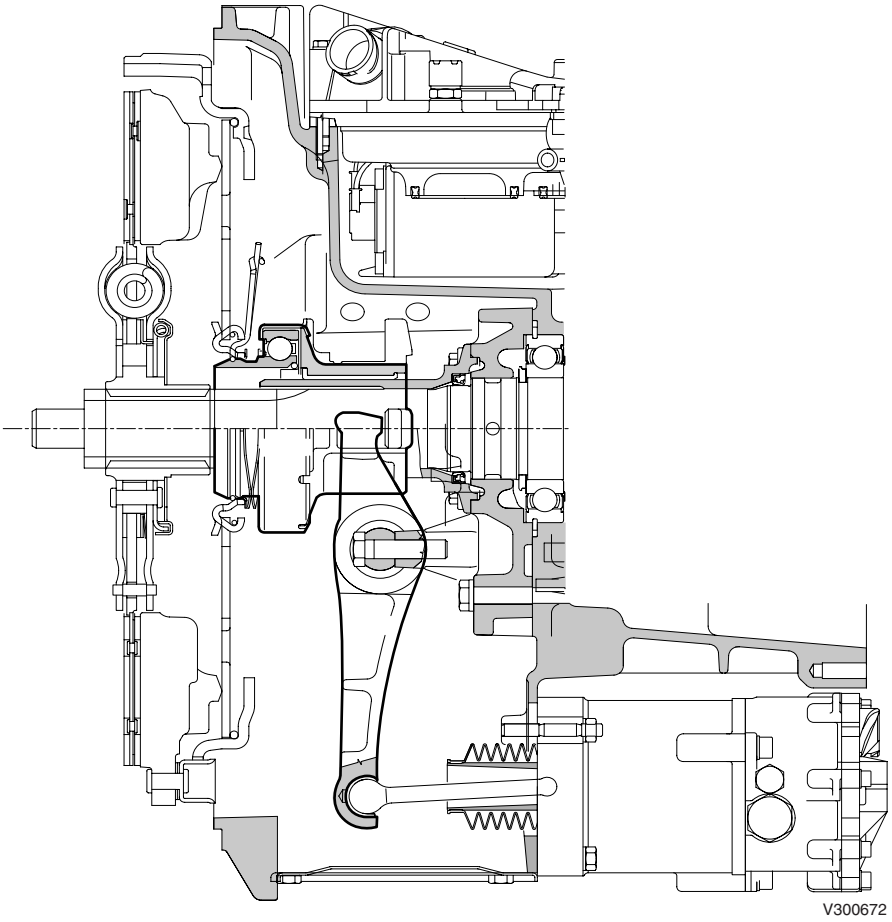


Fig. 2

ZF AS Tronic gearbox clutch



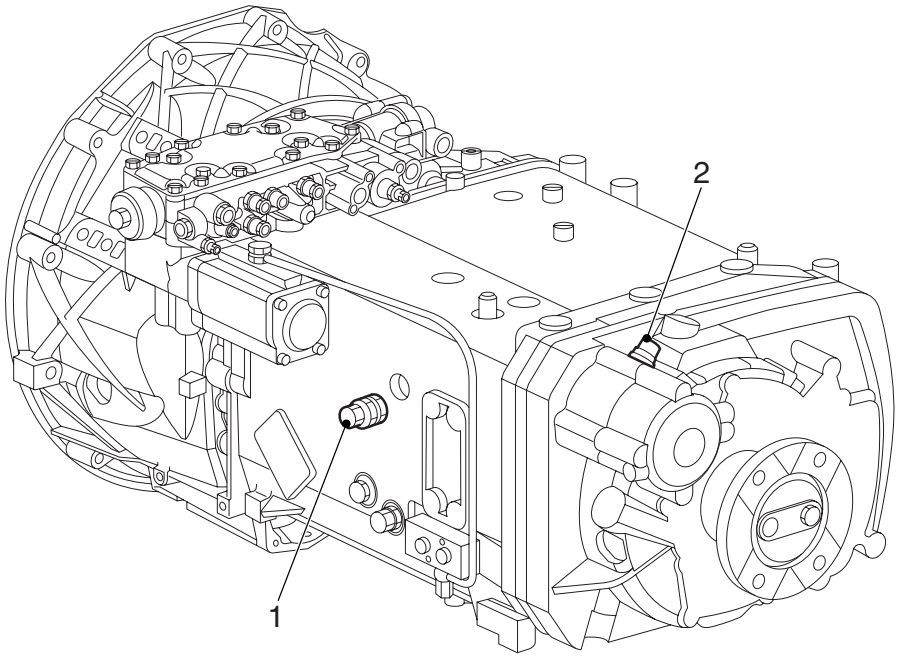
A diaphragm spring requires a self-centring thrust bearing.
The type of clutch plate used depends on the following factors. The size of the clutch plate lining must correspond to the desired service life.
The character of the engine (the engine vibrations to be damped) determines the version of the vibration damper design in the hub.
For the clutch plate to engage smoothly it is necessary that the lining material abuts the flywheel and clutch release assembly evenly at all places when engaging.

The “pull-type clutch” has the following advantages over a “push-type clutch”:
- favourable transfer ratio, resulting in a lighter pedal pressure
- lower weight of the clutch release assembly
- simple clutch release assembly construction.

2.2 SYSTEM DESCRIPTION OF CLUTCH PROTECTION

Pulling off in too high a gear puts excessive stress on the clutch. The clutch protection system makes it difficult to drive off in too high a gear. The clutch protection system prevents driving away in the 3rd or higher gear. If nevertheless a higher gear is selected to pull off in, a yellow warning will be activated on DIP (selected gear too high) and an acoustic signal will sound when accelerating. At the same time the accelerator pedal signal will be ignored, so that acceleration is not possible.

To be able to drive away, a lower gear than the 3rd must be selected. Located on the gearbox are the switches for the gate 3/4 (1) and the low-range switch (2).



1. Gearbox switch for gate 3/4 (F120)
2. Low-range switch (E595)

The VIC electronic unit receives and transmits the signals for the clutch protection system.

The clutch protection system is activated when:
- gearbox is in 3rd gear or higher and
- speed is lower than 5 km/h and
- the clutch is depressed.

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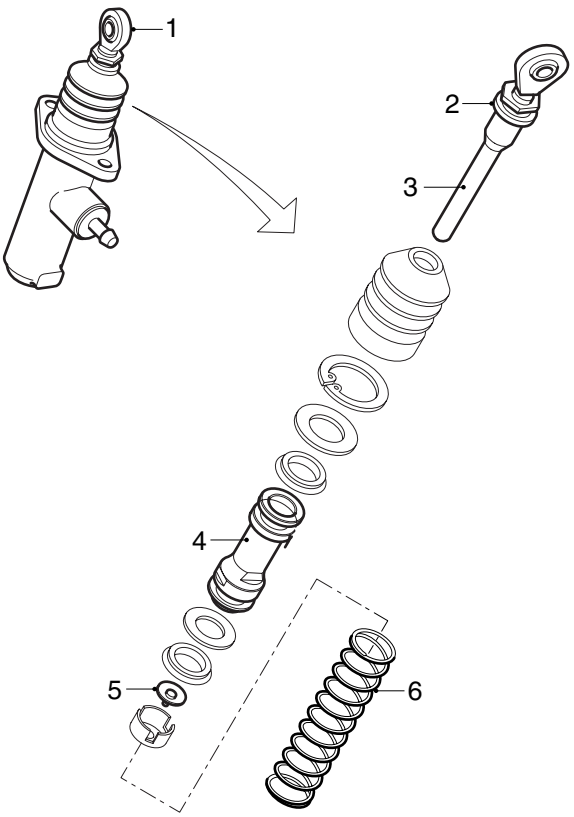
2.3 OVERVIEW DRAWING, MAIN CYLINDER

1. Thrust pin with eye
2. Thrust pin adjustment
3. Thrust pin
4. Piston
5. Valve
6. Spring



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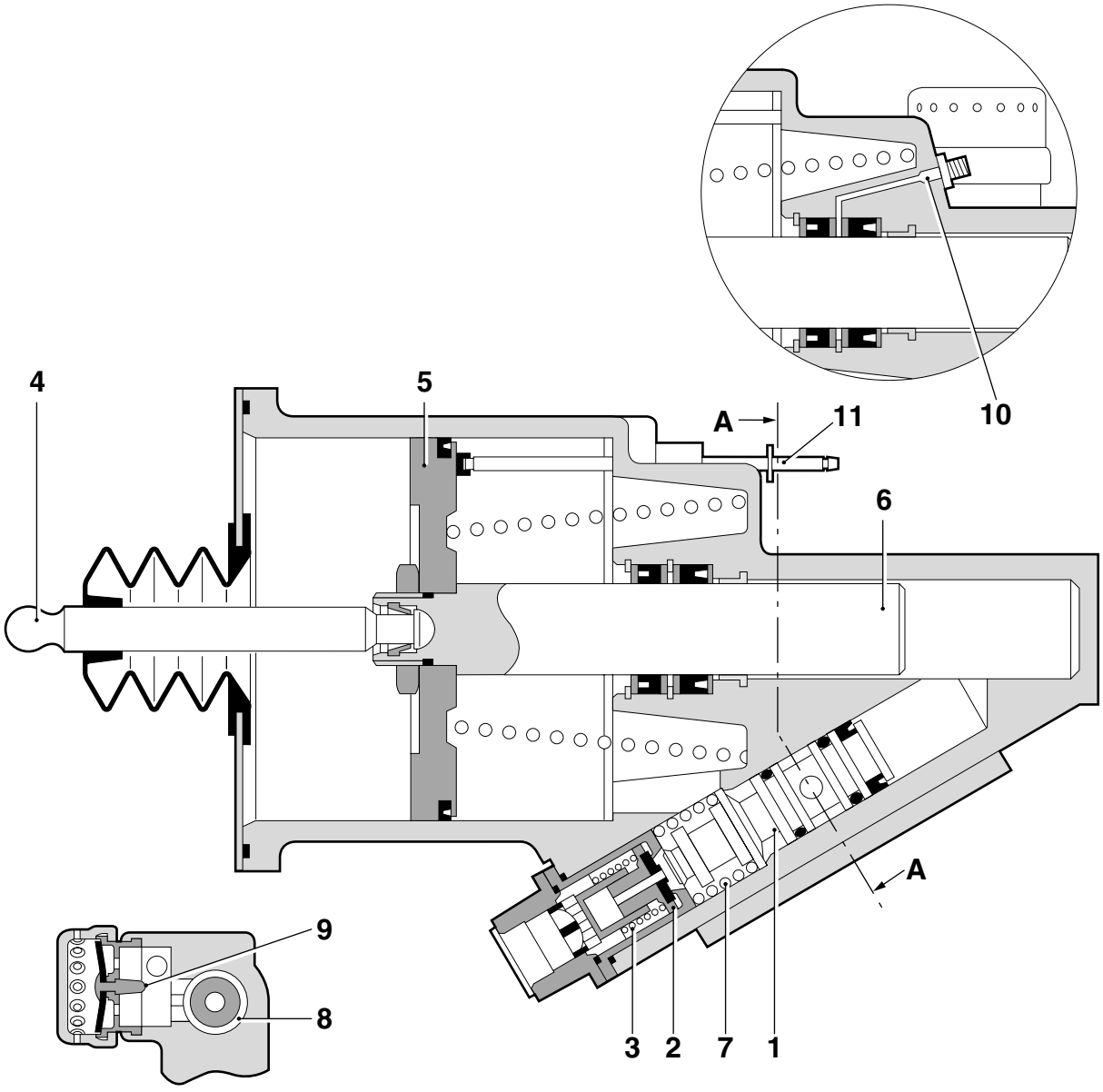
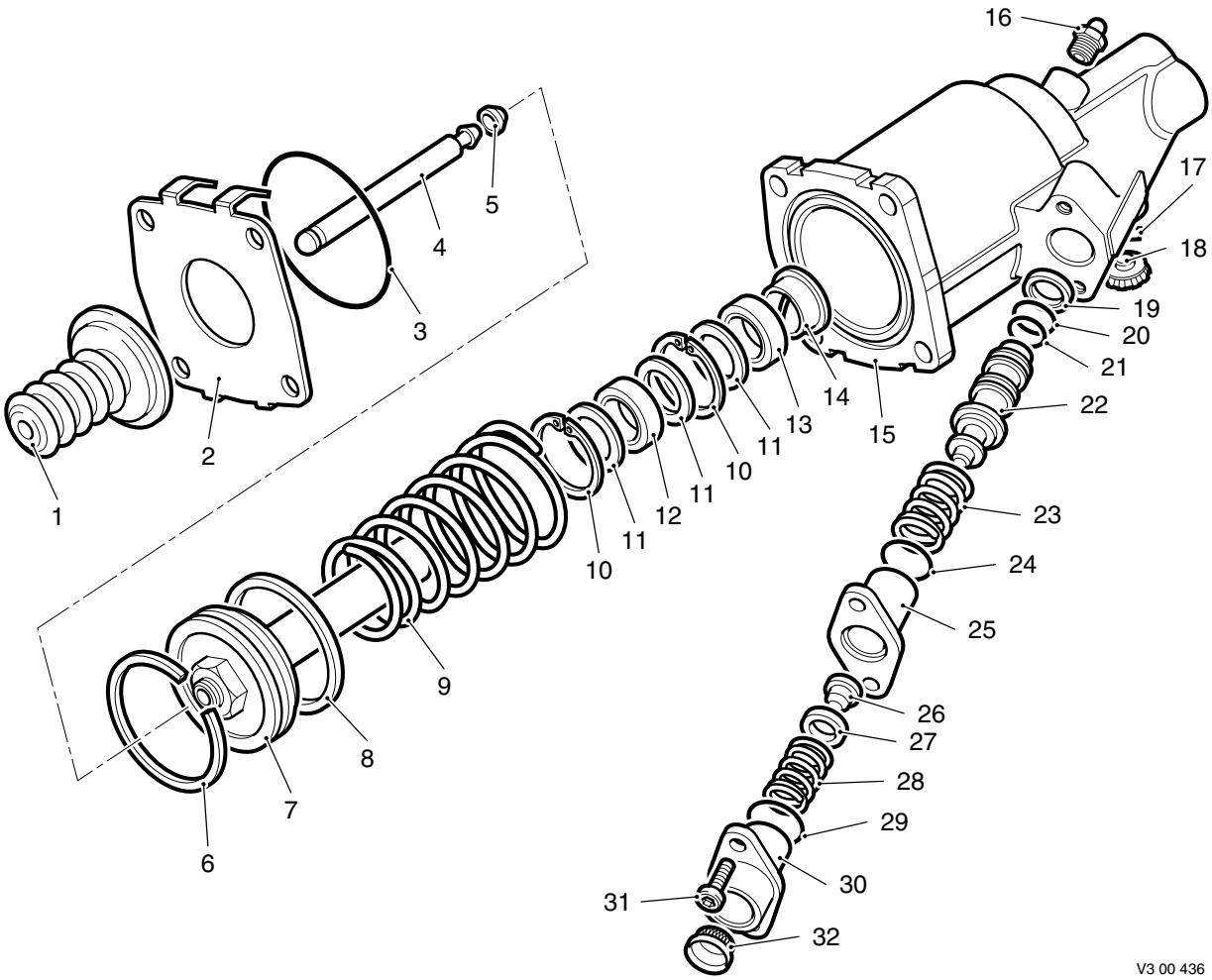
2.4 OVERVIEW DRAWING, *CF*75/85 CLUTCH SERVO



Cross-section A - A

1. Servo piston
2. Air valve
3. Spring
4. Pressure pin
5. Air piston
6. Fluid piston
7. Pressure spring
8. Bleed bore
9. Bleed
10. Vent opening
11. Wear indicator

2.5 OVERVIEW DRAWING, *CF*65 CLUTCH SERVO



1. Rubber protective bellows
2. End-plate
3. O-ring
4. Push rod
5. Fastening ring for push rod
6. Split seal
7. Piston
8. Piston seal
9. Conical spring
10. Circlip
11. Washer
12. Seal, hydraulic part, front
13. Seal, hydraulic part, rear
14. Split bearing
15. Booster housing
16. Bleed nipple
17. Vent opening
18. Blow-off nipple
19. Piston seal
20. O-ring
21. O-ring
22. Piston
23. Pressure spring
24. O-ring
25. Spring seat housing
26. Inlet valve
27. Spring seat
28. Reset spring
29. O-ring
30. Connector housing
31. Socket head screw
32. Air filter

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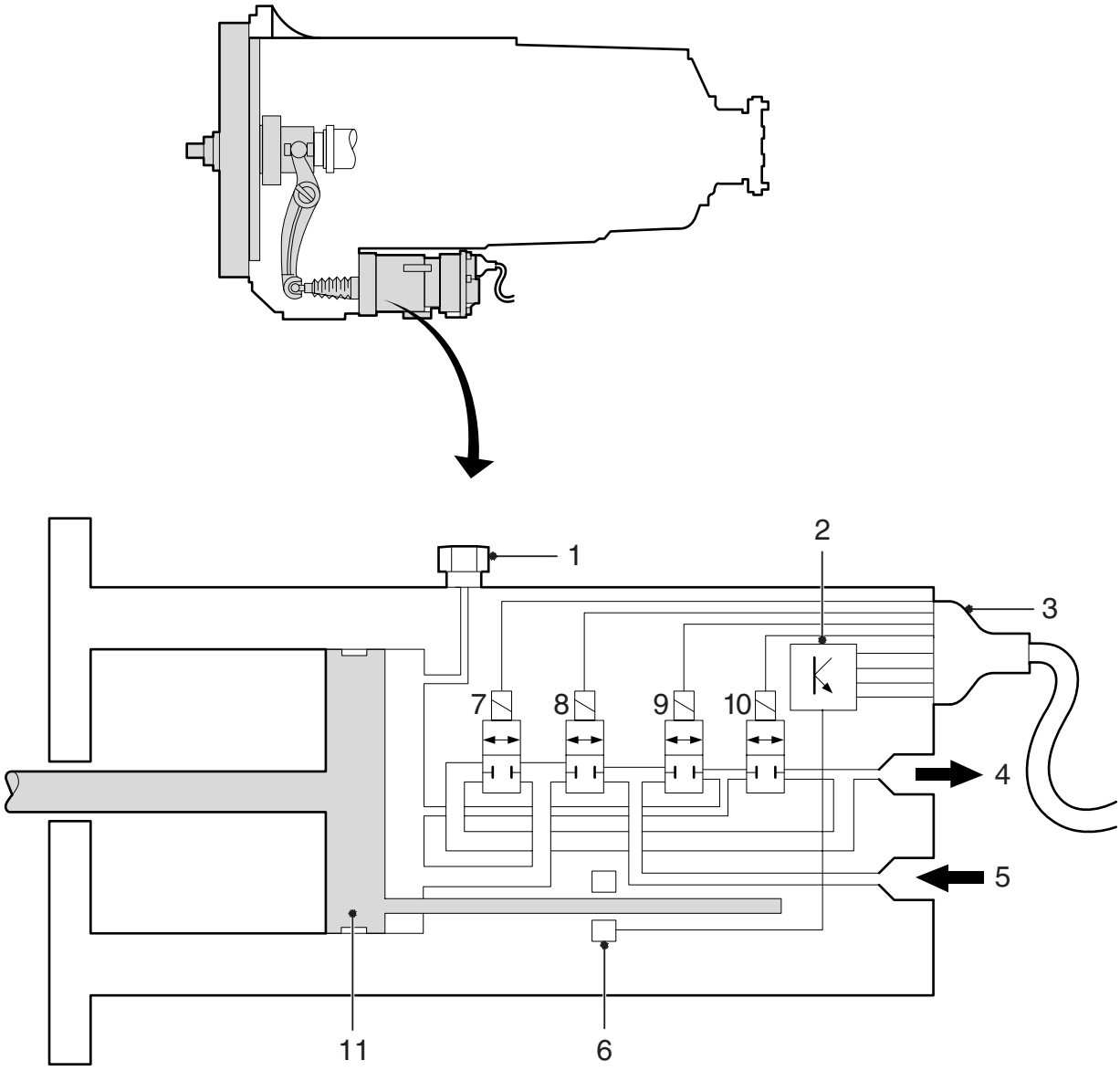
2.6 OVERVIEW DRAWING, AS TRONIC CLUTCH UNIT



1. Bleed screw
2. Electronic unit
3. Cable connection to modulator
4. Bleed
5. Compressed air connection
6. Position sensor
7. “Fast clutching” pneumatic valve
8. “Fast declutching” pneumatic valve
9. “Slow declutching” pneumatic valve
10. “Slow clutching” pneumatic valve
11. Operating piston

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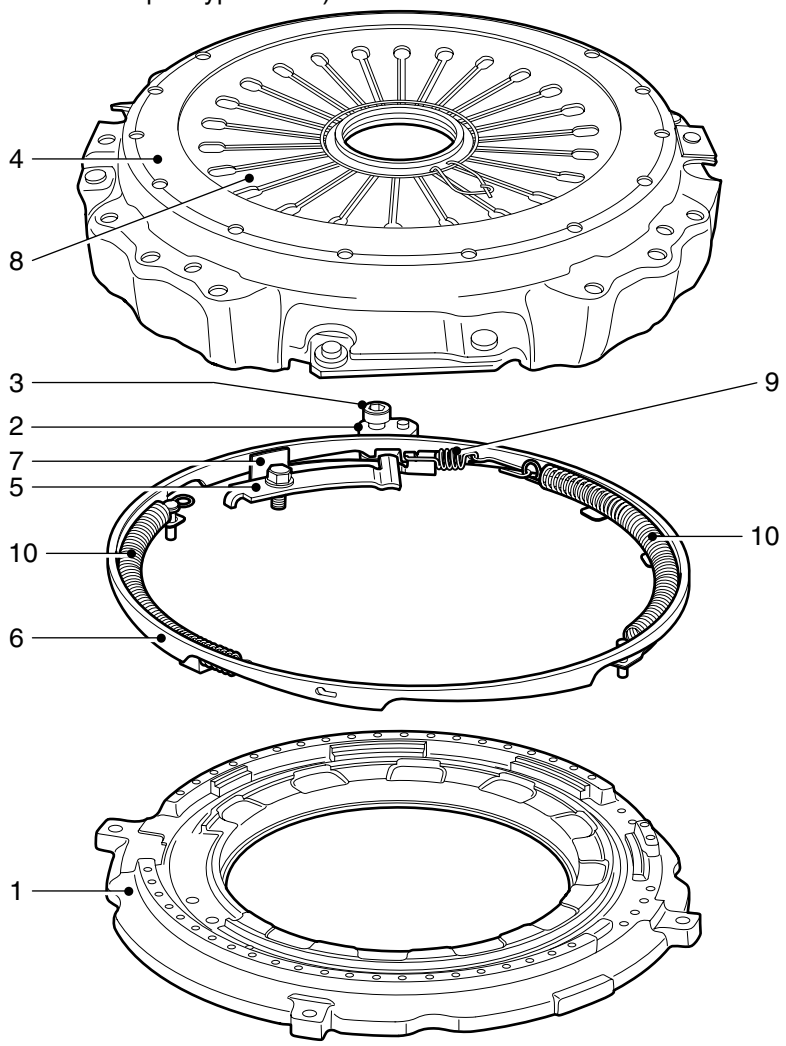
2.7 OVERVIEW DRAWING, AUTOMATICALLY ADJUSTING CLUTCH RELEASE ASSEMBLY

(The example shown here is a pull-type clutch)



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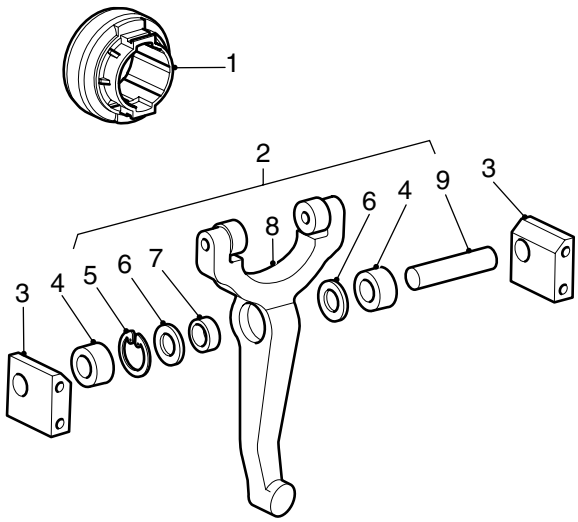
The automatically adjusting clutch release assembly comprises the following parts:

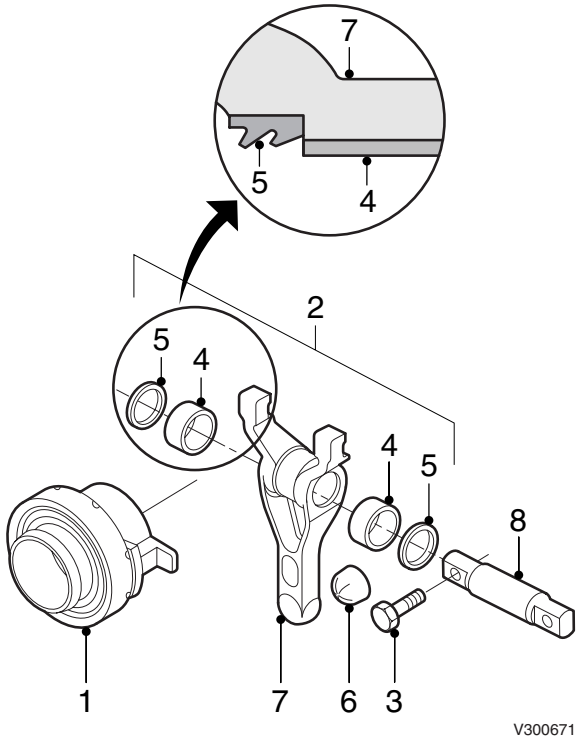
1. Thrust plate
2. Stop plate
3. Stop plate attachment bolt
4. Clutch release assembly cover
5. Stop spring
6. Adjusting ring
7. Slide plate
8. Diaphragm spring
9. Pre-adjusting spring
10. Adjusting spring

2.8 OVERVIEW DRAWING, CLUTCH LEVER ATTACHMENT TO GEARBOX

ZF 16S-151/181/221
1. Bearing
2. Lever assembly
3. Bracket
4. Bearing bush
5. Circlip
6. Shim
7. Lever bearing bush
8. Lever
9. Shaft



AS Tronic
1. Bearing
2. Lever assembly
3. Attachment bolt
4. Bearing bush
5. Oil seal
6. Ball cup
7. Clutch lever
8. Shaft



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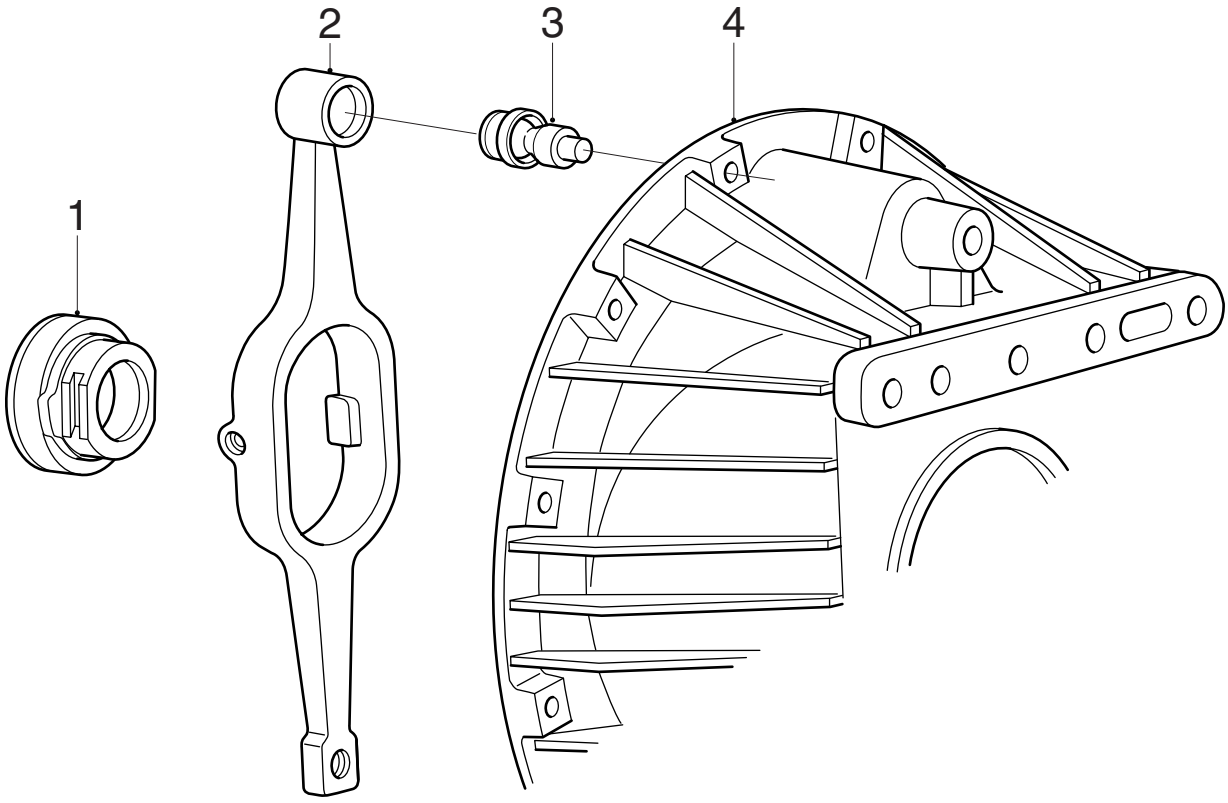
2.9 OVERVIEW DRAWING, CLUTCH LEVER ATTACHMENT TO CLUTCH HOUSING



1. Thrust bearing
2. Lever
3. Ball joint
4. Clutch housing

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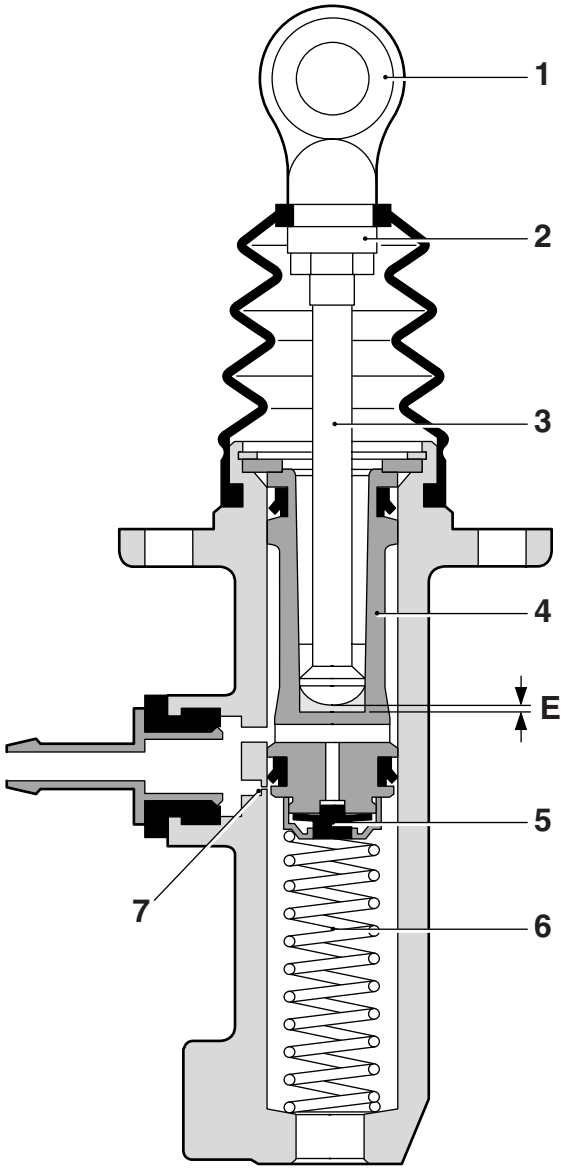
3. DESCRIPTION OF COMPONENTS

3.1 MAIN CYLINDER

When the clutch pedal is depressed, the thrust pin (3) will move the piston (4) down against the spring (6).
As a result, the valve (5) closes and the pressure starts to build up as the sleeve passes the bore hole (7) to the reservoir.

When the clutch pedal is released, the spring (6) ensures that the piston (4) returns to the original position.
Any shortage of fluid underneath the piston (4) is refilled via a bore hole in the piston (6) and the valve (5).
It is important that after depressing the clutch pedal, the piston (4) returns fully to the original position, so that the 0. 6 mm compensation hole (7) is not closed by the seal on the piston (4).
If the compensation hole is not entirely free, residual pressure will build up, causing excessive damage to the clutch mechanism.
The piston (4) can return fully to the original position if there is sufficient play (E) between the thrust pin (3) and the piston (4). See “Technical data”.



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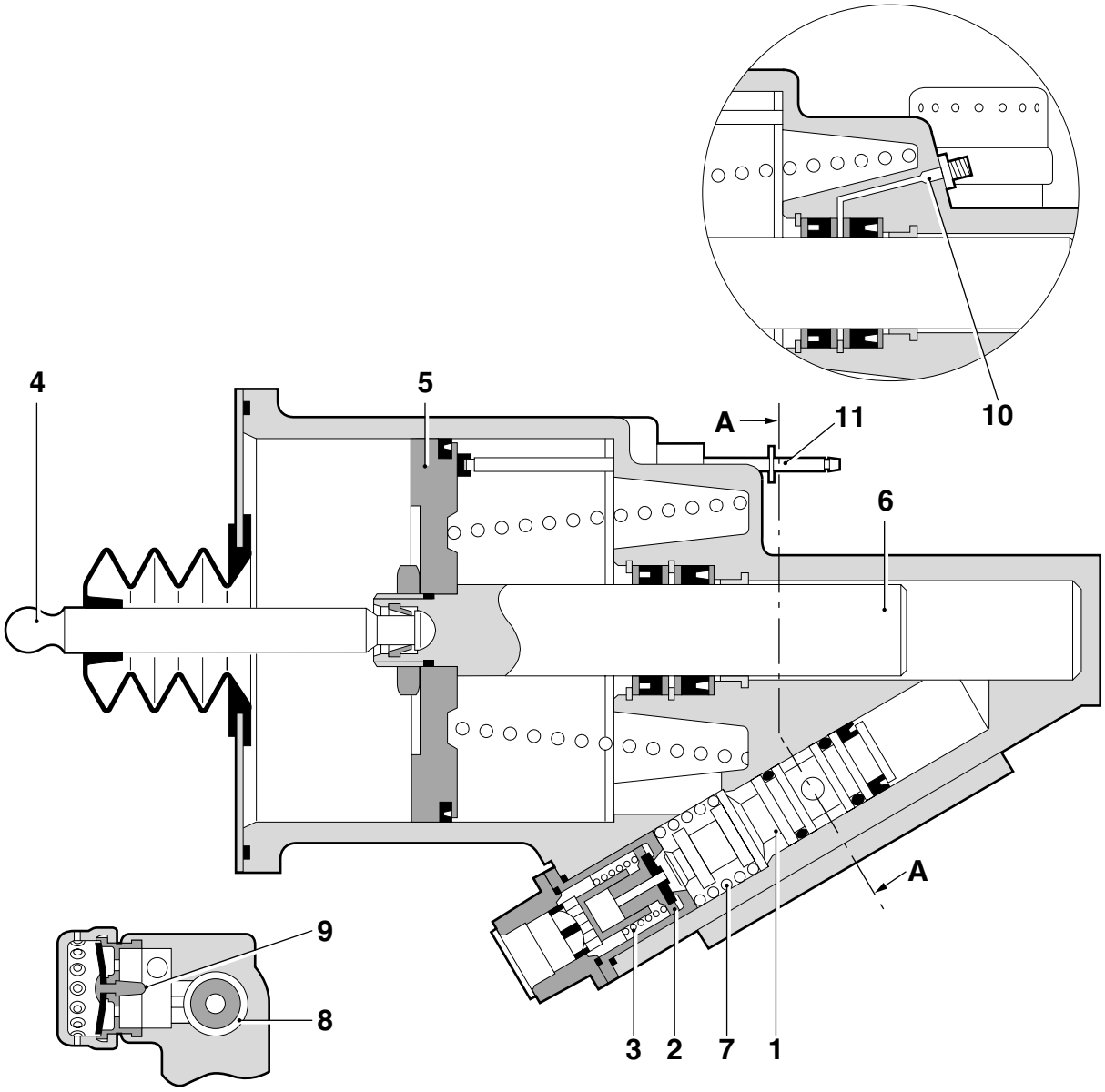
3.2 *CF*75/85 CLUTCH SERVO



Cross-section A - A

Declutching
Depressing the clutch pedal results in a build-up of hydraulic pressure.

This causes the servo piston (1) to push the air valve (2) from the valve seat, against the force of the spring (3).

Air pressure now flows into the cylinder.

The pressure pin (4) is pushed forward by the air pressure building up on the air piston (5) and the hydraulic pressure on the fluid piston (6).

The pressure pin (4) pushes against the clutch lever, which results in declutching.

State of equilibrium
When the hydraulic pressure and pneumatic support push the pressure pin (4) forwards, a state of equilibrium is achieved between the air pressure and hydraulic pressure (status when the clutch pedal is not depressed any further).

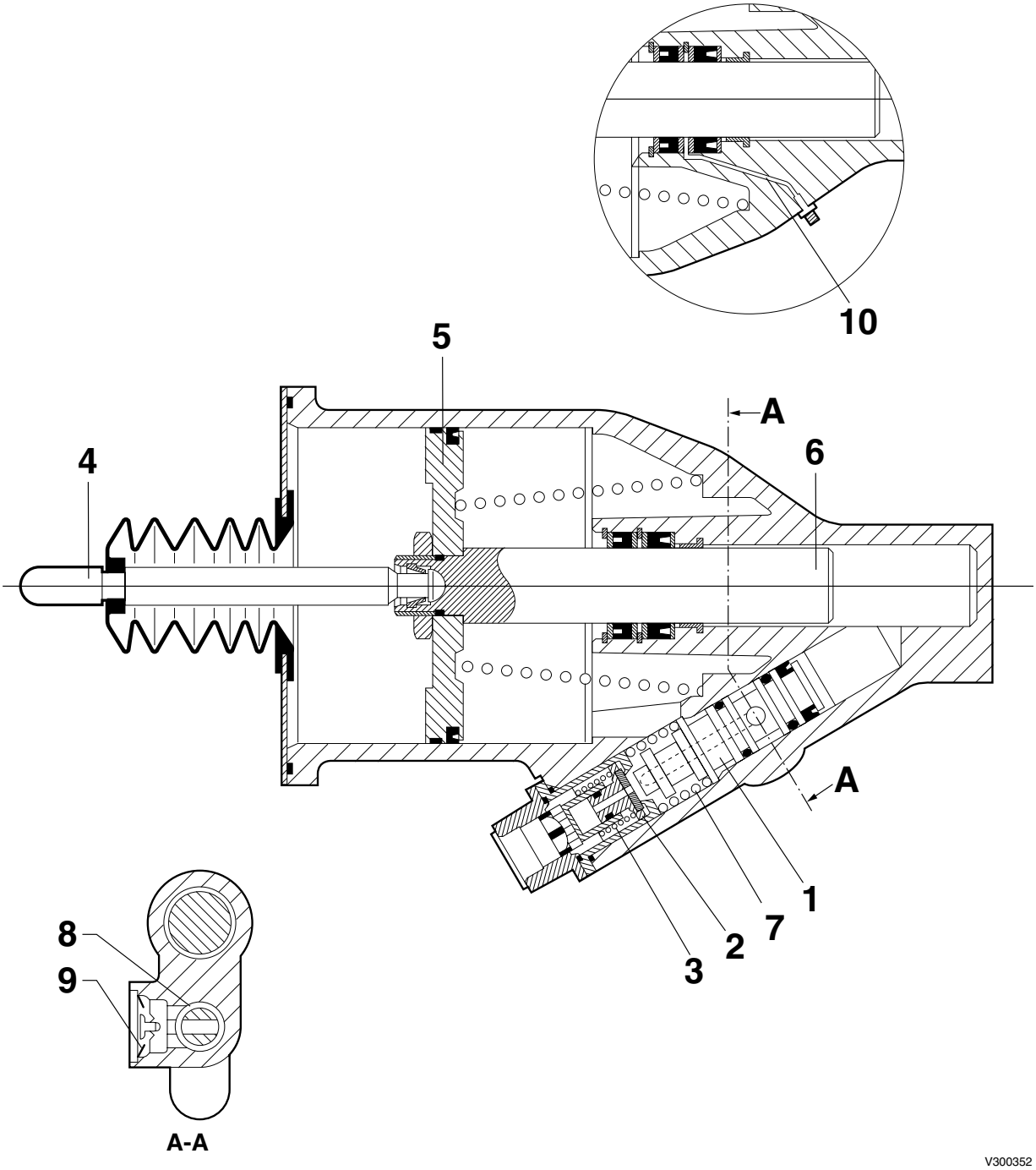
The servo piston (1) again seals off against the valve seat, closing the air supply and stopping the build-up of pneumatic pressure.

Clutching
When the clutch pedal is released, there is no longer any hydraulic pressure and the servo piston (1) will be pushed back into its original position by the pressure spring (7) and any remaining pneumatic support.

As a result, the bleed bore (8) in the servo piston (1) is no longer closed, and bleeding takes place via the bleed vent (9).

Vent opening
The function of the vent opening (10) is to prevent a build-up of pressure between both piston seals.

3.3 *CF*65 CLUTCH SERVO



Cross-section A - A

Declutching
Depressing the clutch pedal results in a build-up of hydraulic pressure.

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This causes the servo piston (1) to push the air valve (2) from the valve seat, against the force of the spring (3).

Air pressure now flows into the cylinder.

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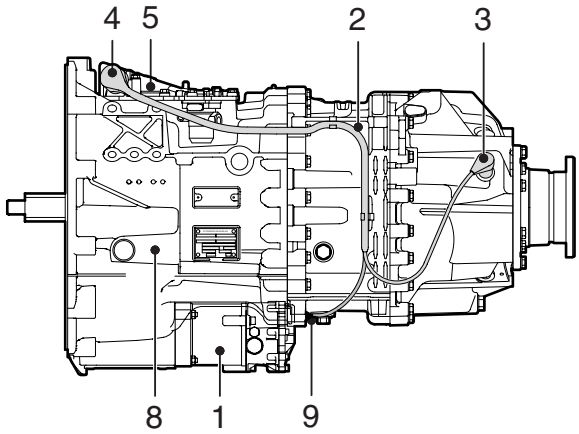
Vent opening
The function of the vent opening (10) is to prevent a build-up of pressure between both piston seals.

3.4 AS TRONIC CLUTCH UNIT

The clutch unit (1) is attached to the integrated clutch housing of the gearbox.



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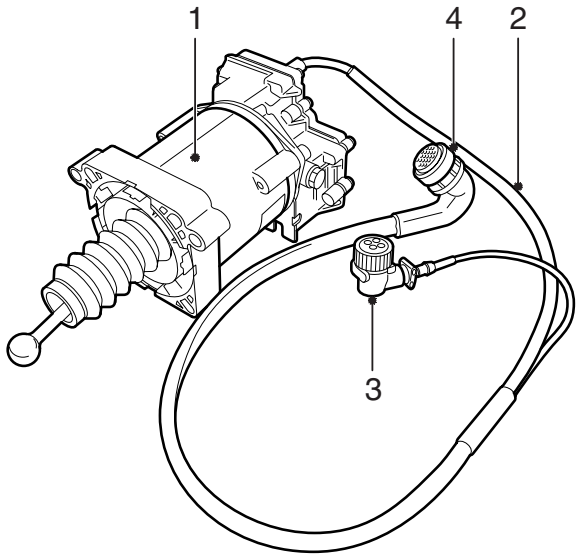
With AS Tronic gearboxes, the clutch is operated fully automatically by the electropneumatic clutch unit (1), which, in its turn, is controlled by the electronics inside the gearbox modulator (5). The wiring harness (2) connects the clutch unit to the modulator (5). The wiring harness connects the clutch unit (9) to the gearbox modulator (5) via a connector (4).



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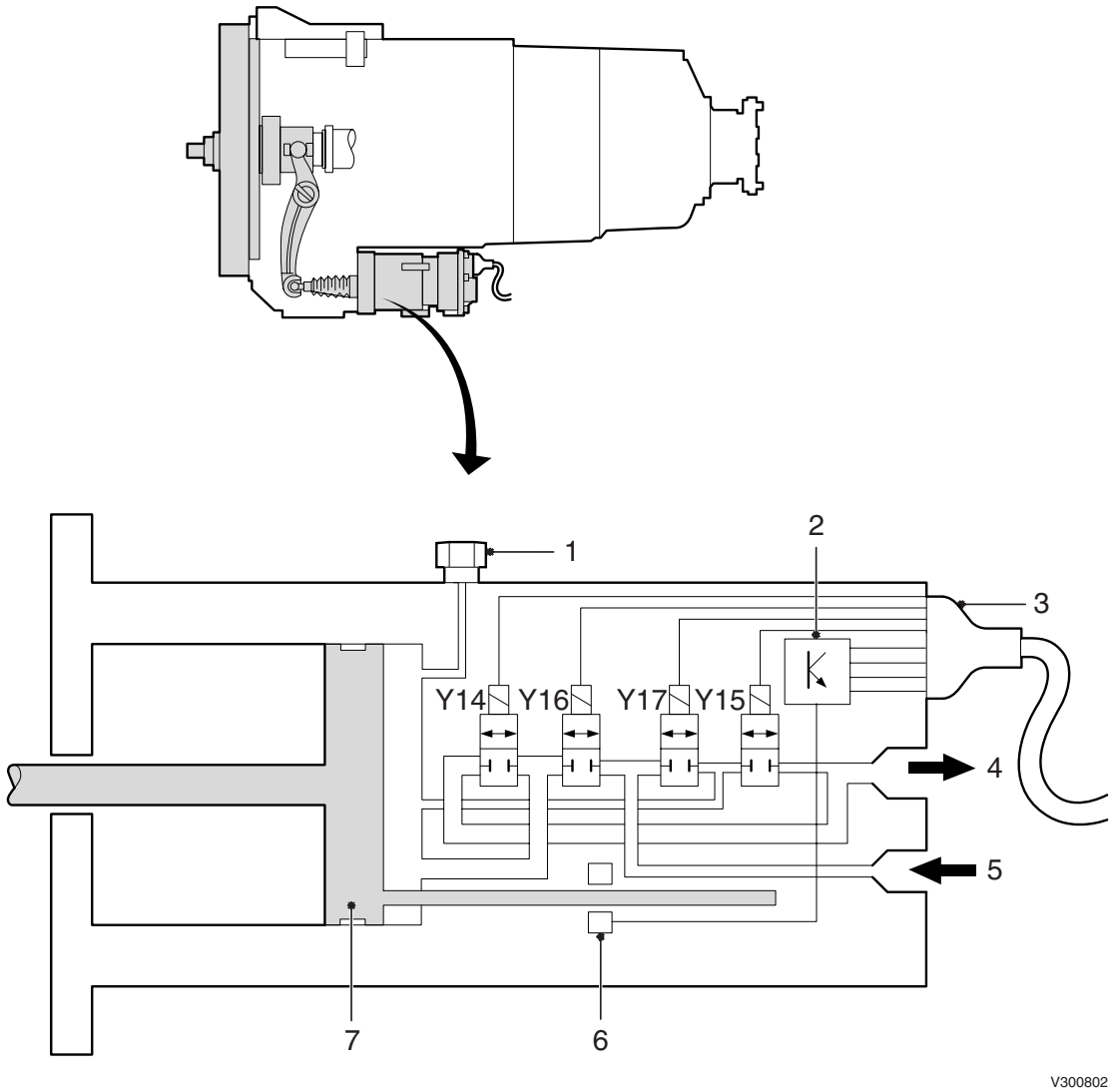


The clutch unit does not just consist of the pneumatic operating piston (7), but also of four pneumatic valves, which can open or close the clutch either fast or slowly.
Valve Y16 is for fast declutching, valve Y17 for slow declutching. Valve Y15 has the clutch engage slowly, valve Y14 has it engage quickly.

The moment of engaging and the position and stroke of the operating piston are processed by the travel sensor (6) and the electronics (2) and then transmitted to the modulator. In this way the modulator can adjust the opening and closing of the clutch to the driving conditions.

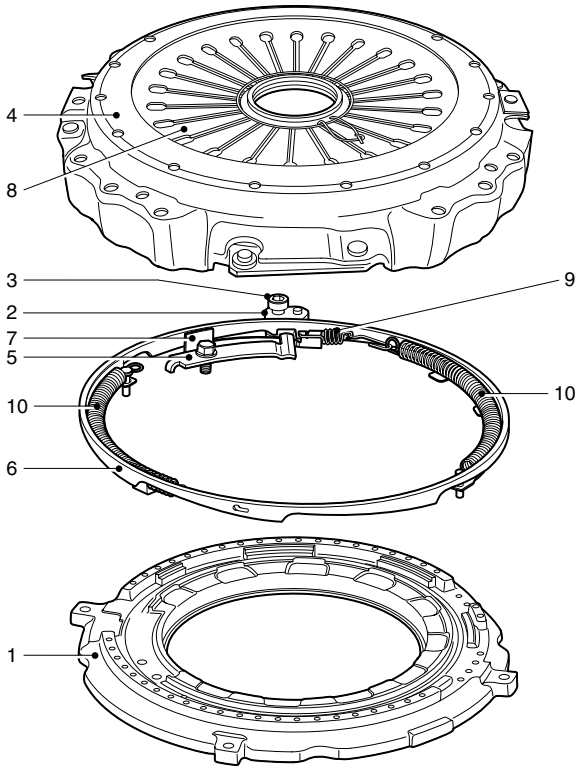
A bleed screw (1) has been fitted to enable manual bleeding of the clutch unit.

10

3.5 AUTOMATICALLY ADJUSTING CLUTCH RELEASE ASSEMBLY

Automatically adjusting clutch release assembly
The clutch can be fitted with an automatically adjusting clutch release assembly. The automatically adjusting clutch release assembly is used in both the push and pull clutch types. The automatic assembly is always combined with a clutch plate with a clearance of 5 mm for lining wear.
This is due to the fact that the lining material is bonded to the clutch plate.
A conventional clutch has a lining wear clearance of 3 mm, as the lining material is riveted to the clutch plate. The increase in lining wear clearance extends the service life of the clutch.

With a conventional clutch, wear of the clutch plate causes the rest position of the diaphragm spring to change.
The clutch release assembly automatically compensates for the rest position of the diaphragm spring as the clutch plate wears.
Disadvantages such as a change in the contact pressure of the assembly and an increase in the force required to operate the clutch are avoided.



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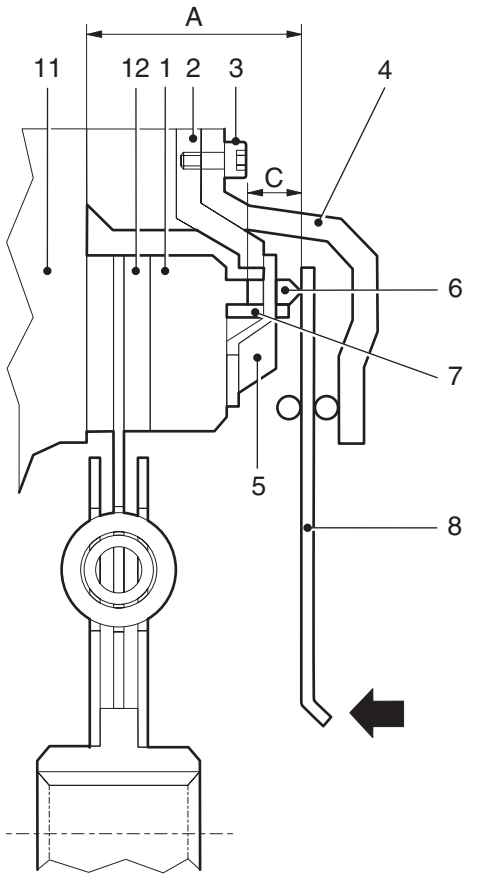
A push-type clutch with an automatically adjusting clutch release assembly is described here as an example.

As the result of wear, the lining of the clutch plate becomes thinner and the distance (A) between the flywheel and the diaphragm spring decreases. However, distance A is kept constant by the automatically adjusting clutch release assembly. The adjustment (compensation) takes place as the clutch is operated by temporarily relieving the contact pressure of the diaphragm spring.



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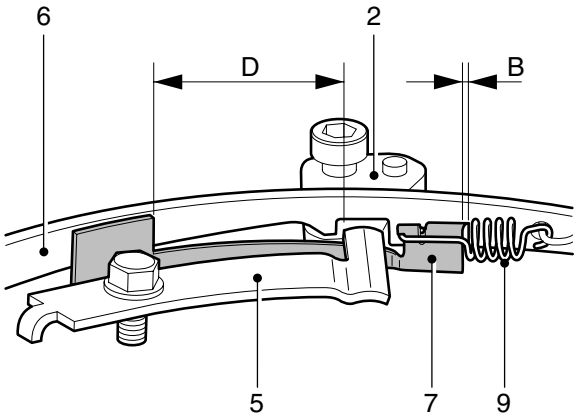
Compensation of rest position of diaphragm spring
The adjustment takes place as follows: as the clutch plate (12) wears, the thrust plate (1) moves towards the flywheel (11). This causes the stop plate (2) to bend the stop spring (5), which is fastened to the thrust plate (1), upwards proportionately. The stop plate (2) is fastened to the clutch release assembly cover (4).
The pre-adjusting spring (9) will now pull the slide plate (7) against the adjusting ring (6). This eliminates the gap (B) in the recess of the adjusting ring (6). The rising end of the slide plate (7) also locks under the stop spring (5).



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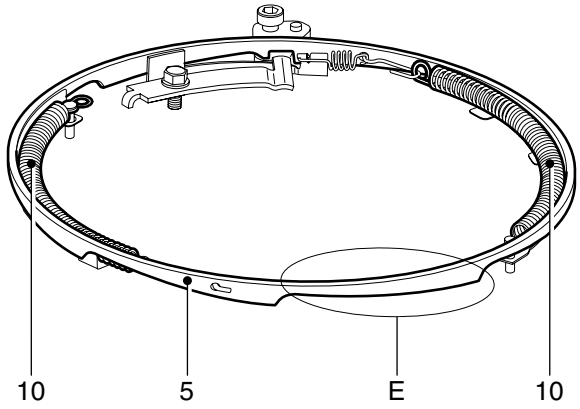
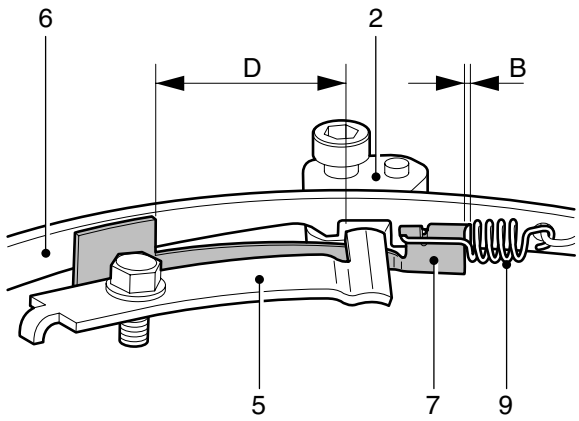
The adjusting ring (6) twists as a result of the tension applied by the adjusting springs (10). The adjusting ring twists by the same amount as the former gap (B) in the recess in the adjusting ring (6).
The contact surface (E) between the adjusting ring and the thrust plate is wedge-shaped. Adjusting the adjusting ring (6) causes it to move upwards. This causes the space (C) between the thrust plate (1) and the diaphragm spring (8) to close. When the clutch is no longer being used, the diaphragm spring will return to the same rest position. This procedure compensates for wear in the clutch plate and ensures that the diaphragm spring always returns to the same rest position.



V300486

Compensation occurs during the first 4 mm of clutch plate wear.
This is determined by the maximum adjustment distance (D). Adjustment ceases when the slide plate (7) rests against the stop of the stop spring (5).
Once the clutch plate has worn by 4 mm, the automatically adjusting clutch behaves as a conventional clutch if there is any further wear.

In other words, the position of the diaphragm spring will change once there is more than 4 mm of wear.
This results in a change in the position of the clutch lever and the clutch servo thrust pin and in the position of the wear indicator. The wear indicator will only give a wear indication during the last millimetre of wear of the clutch plate lining.



V300485

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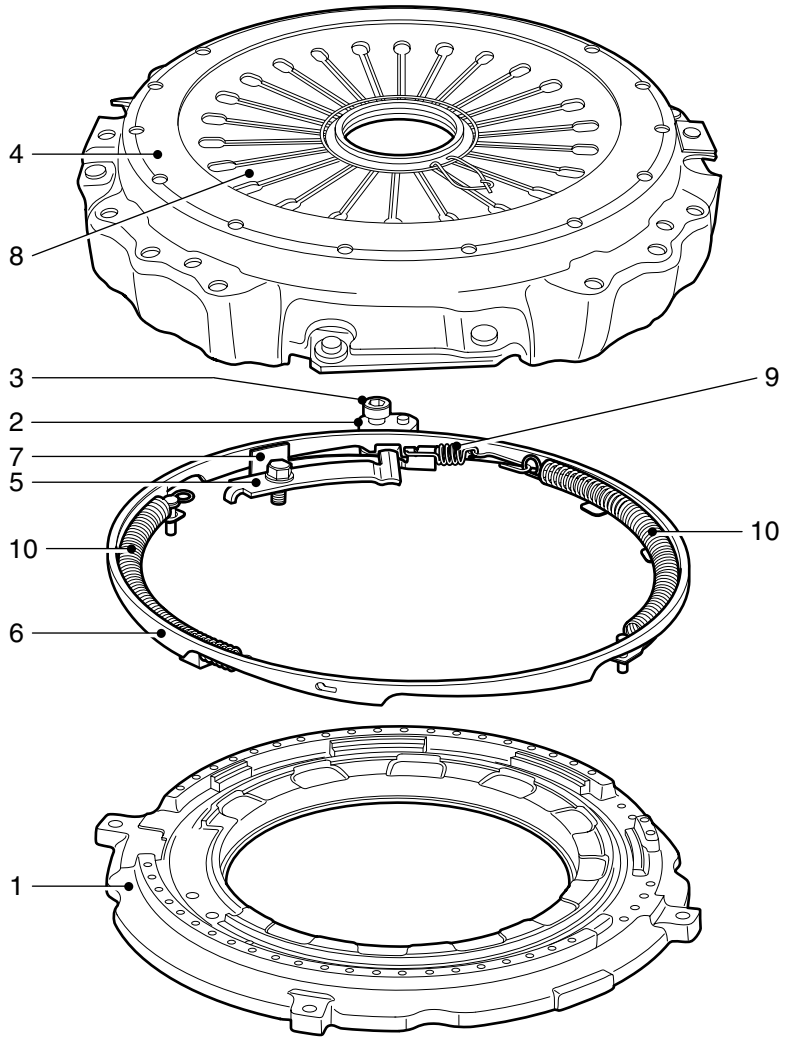
The automatically adjusting clutch release assembly comprises the following parts:



1. Thrust plate
2. Stop plate
3. Stop plate attachment bolt
4. Clutch release assembly cover
5. Stop spring
6. Adjusting ring
7. Slide plate
8. Diaphragm spring
9. Pre-adjusting spring
10. Adjusting spring

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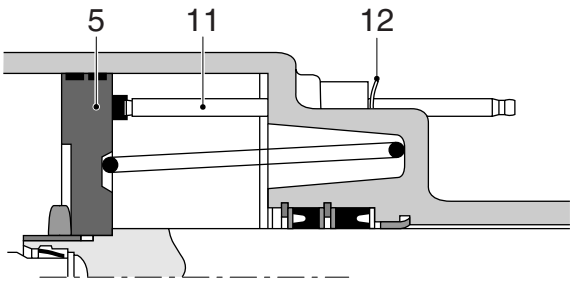
3.6 *CF*75/85 CLUTCH WEAR INDICATOR

***CF*75 and *CF*85 wear indicator**
The wear indicator consists of a pin (11) which protrudes out of the clutch servo housing. The part of the pin within the clutch servo lies loose against the air piston (5). A circlip (12) is placed on the outer part of the pin.



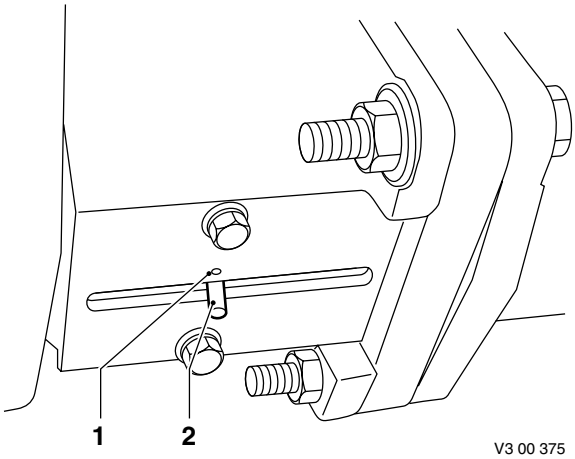
V300355

This circlip must be pressed against the clutch servo during the first service inspection. It is not allowed to remove the circlip or to move the circlip over the pin. This is to prevent inaccurate indication.

When the clutch plate shows wear of around 80%, the air piston (5) will push the pin (11) outwards. The reason for this is that the automatically adjusting clutch assembly cannot be adjusted any more when the clutch plate shows wear of 80%. Among other things, the position of the air piston (5) and consequently the pin (11) changes. The circlip (12) on the pin (11) will no longer lie against the housing of the clutch servo. The movement of the (indicator) circlip (12) may be approx. 10 mm.

3.7 *CF*65 CLUTCH WEAR INDICATOR

***CF*65 wear indicator**
There is an indicator (2) mounted on the clutch servo pressure pin. The end of the indicator can be seen in the indicator cover groove.
When the clutch plate shows a wear of around 80%, the indicator (2) will assume a different position in relation to its initial position. The initial position is indicated by a mark (1) on the indicator cover. The maximum movement of the indicator is around 5 mm.



V3 00 375

The mark is made on the indicator cover by means of a centre punch. The mark must be placed in precise correspondence to the centre of the indicator.
This must be done during the first service inspection.

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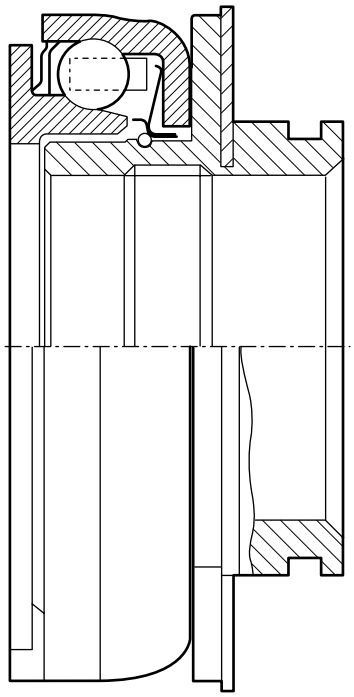
3.8 THRUST BEARING

The *CF*65/75/85-series has two versions of thrust bearing, one with and one without plastic coating.

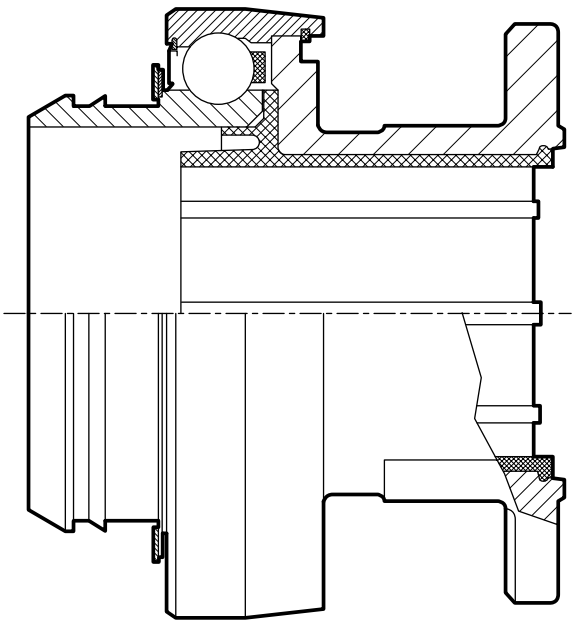
The thrust bearing without plastic coating can be recognised by the aluminium lining on the inner diameter.



V300288

The thrust bearing with plastic coating can be recognised by the spline-shaped inner diameter.

When fitting the thrust bearing with plastic coating, do not use lubricating grease.
The lubricating grease will attack the plastic coating and shorten the service life of the thrust bearing.



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4. INSPECTION AND ADJUSTMENT

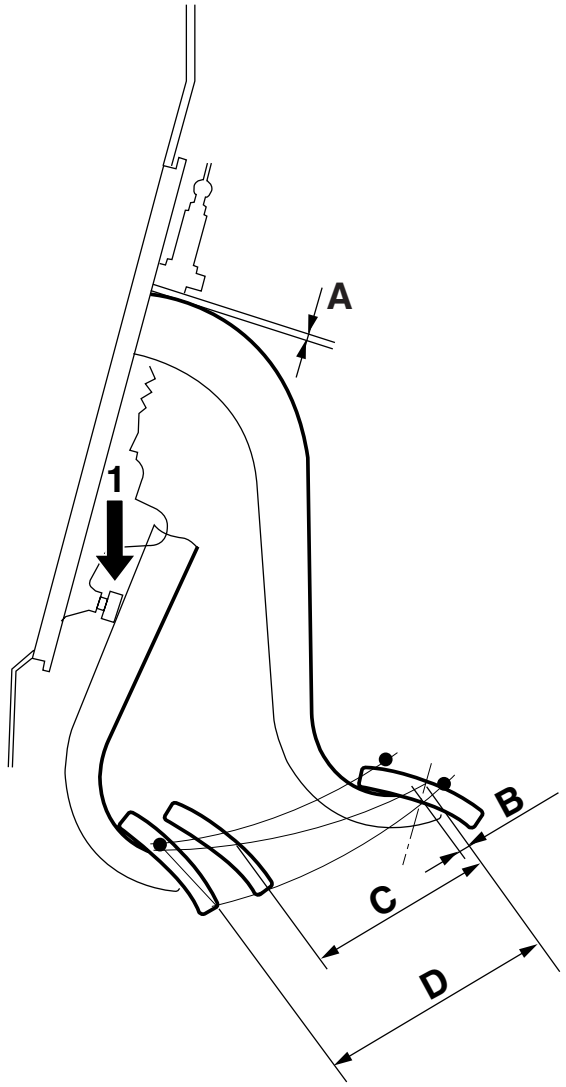
4.1 INSPECTION AND ADJUSTMENT, CLUTCH PEDAL

Inspection, clutch pedal

1. Check the total travel (D) of the clutch pedal: see “Technical data”.
2. Check the free travel (B) of the clutch pedal: see “Technical data”. The free travel (B) can be clearly felt by manually depressing the clutch pedal in from its rest position.

Adjustment, clutch pedal

1. Use the adjusting screw (1) to adjust the total travel (D): see “Technical data”.



V300315

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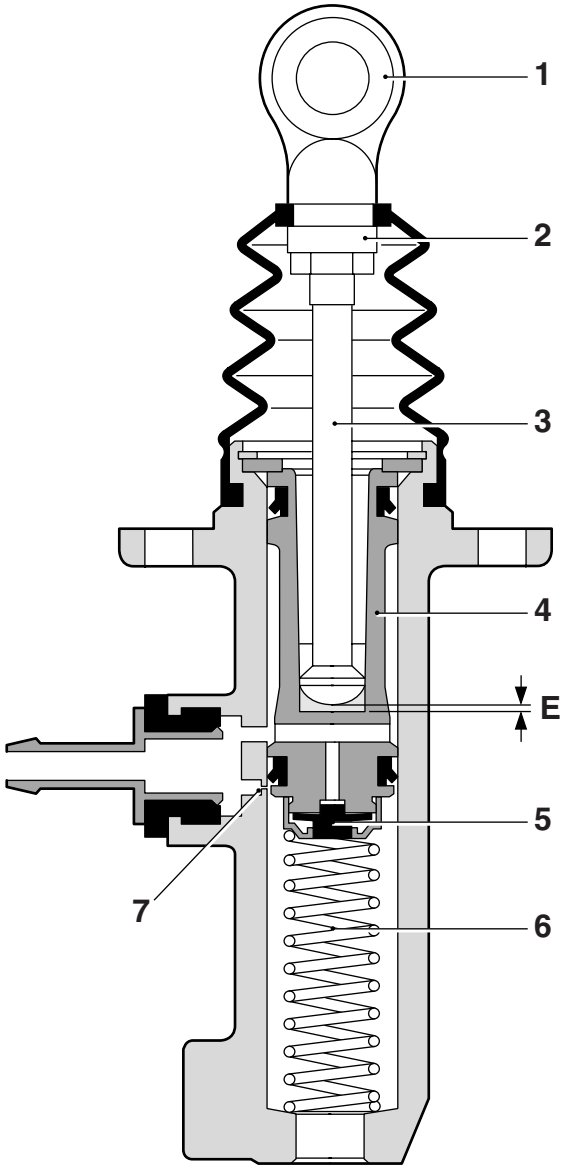
2. The free travel (B) of the clutch pedal is set indirectly by loosening the lock nut (2) and then screwing the ball joint (1) into or out of the thrust pin (3). This sets the distance (E) between the thrust pin (3) and the piston (4) in the main cylinder: see “Technical data”.



V300411

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4.2 INSPECTION, CLUTCH SERVO

Hydraulic fluid is toxic and can have a damaging effect on your health. Direct or indirect physical contact should therefore be avoided.
As hydraulic fluid is also a corrosive fluid, it may damage the paintwork of the vehicle. Avoid any contact between hydraulic fluid and paintwork.

Always use new and clean hydraulic fluid which has been kept in a sealed container that meets the specifications.
Hydraulic fluid which has absorbed water (from the ambient air) may have an adverse effect on the operation of the clutch system.
Avoid any contact with mineral oil. Even one drop of mineral oil in the system will damage the seals.

1. Pressurise the air system.
2. Check for any air leakage via the clutch servo bleed vent.
3. Depress the clutch pedal and check whether there is any leakage via the clutch servo bleed vent.

   Note:
   When the clutch pedal is released, the clutch servo should bleed itself via this bleed vent.
4. Depress the clutch pedal and check that there is no leakage via the clutch servo bleed vent.

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5. Check that there is no leakage via the vent opening (10).

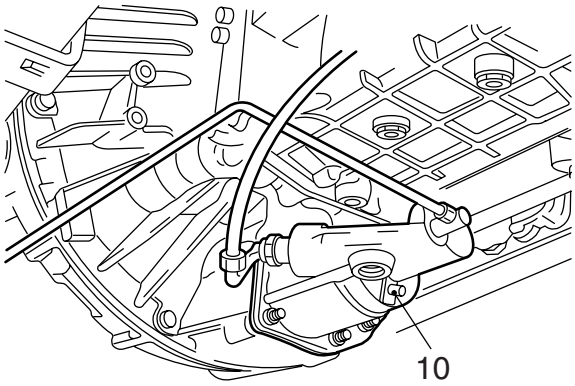
   Note:
   A drop of oil on the vent opening (10) is normal and is not a reason to replace the clutch servo.

   If there is constant leakage, the clutch servo must be repaired or replaced.

   If in doubt as to whether the clutch servo situation is normal or whether there is a leak, inspect the fluid level in the clutch reservoir.

6. Depress the clutch pedal and check whether there is a leak via the vent opening (10).

7. On the clutch servos of the *CF*75/85 with wear indicator check for leakage at the pin through-feed. Depress the clutch pedal and check whether there is an air leak via the pin through-feed.



V300289

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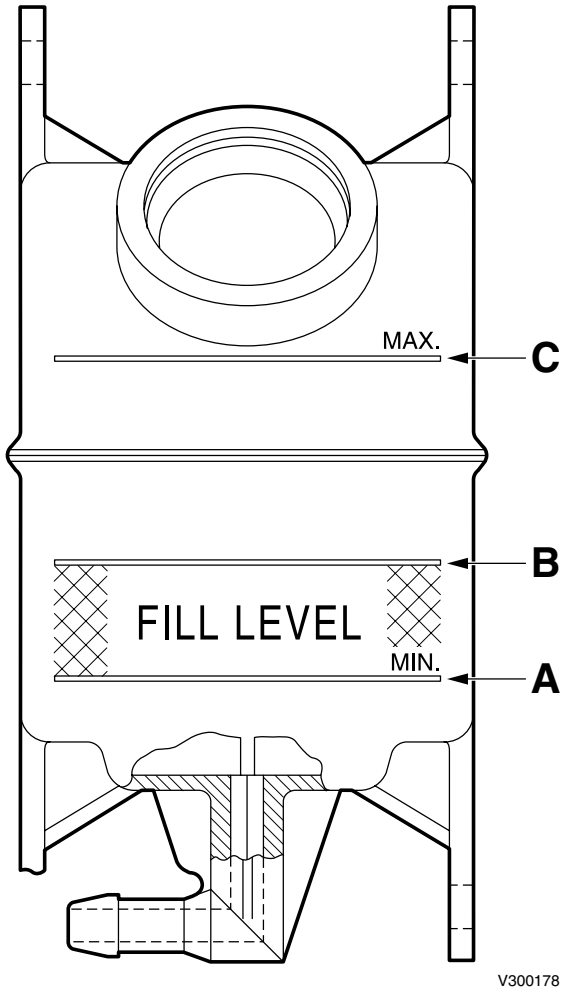
4.3 INSPECTION, CLUTCH FLUID LEVEL

Hydraulic fluid is toxic and can have a damaging effect on your health. Direct or indirect physical contact should therefore be avoided. As hydraulic fluid is also a corrosive fluid, it may damage the paintwork of the vehicle. Avoid any contact between hydraulic fluid and paintwork.

Always use new and clean hydraulic fluid which has been kept in a sealed container that meets the specifications. Hydraulic fluid which has absorbed water (from the ambient air) may have an adverse effect on the operation of the clutch system. Avoid any contact with mineral oil. Even one drop of mineral oil in the system will damage the seals.

1. Check whether the fluid level is between the A and B marks when the cab is in the driving position.
2. Mark C applies to fully tilted cabs.
3. Fit the reservoir sealing cap by hand.

   Note:
   The dop contains a bleed vent.
   If the bleed vent is closed off, residual pressure will build up in the system



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5. REMOVAL AND INSTALLATION

5.1 REMOVAL AND INSTALLATION, CLUTCH SERVO

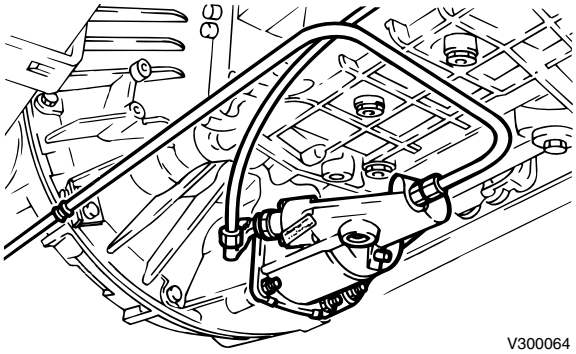
Hydraulic fluid is toxic and can have a damaging effect on your health. Direct or indirect physical contact should therefore be avoided.
As hydraulic fluid is also a corrosive fluid, it may damage the paintwork of the vehicle. Avoid any contact between hydraulic fluid and paintwork.

Always use new and clean hydraulic fluid which has been kept in a sealed container that meets the specifications. Hydraulic fluid which has absorbed water (from the ambient air) may have an adverse effect on the operation of the clutch system.
Avoid any contact with mineral oil. Even one drop of mineral oil in the system will damage the seals.

Removing the clutch servo

1. Remove the air pipe from the clutch servo.
2. Place a container beneath the clutch servo and remove the fluid pipe. Then plug the pipe.
3. **Note:**
   The clutch servo is mounted on the clutch housing under pre-tension.

   Remove the attachment nuts from the clutch servo.


V300064

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Installing the clutch servo

1. Fit the clutch servo. Make sure that the thrust pin fits into the cup-shaped recess in the clutch lever.

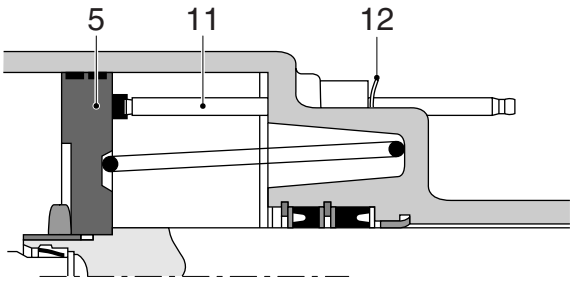
   Note:
   If the clutch servo with wear-indicator is used in the *CF*65, pay attention to the following.
   Make sure that the thrust pin fits into the cup-shaped recess in the wear-indicator.

2. Tighten the attachment nuts evenly.

3. After mounting clutch servos equipped with a wear pin, the pin (11) must be pushed against the air piston (5), and the circlip (12) must be pushed against the clutch servo housing.

4. Fit the air pipe and the fluid pipe.

5. Fill and bleed the clutch system.



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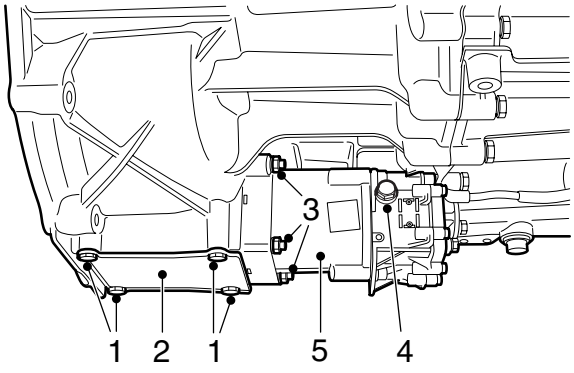
5.2 REMOVAL AND INSTALLATION, AS TRONIC CLUTCH UNIT

Removing the clutch unit

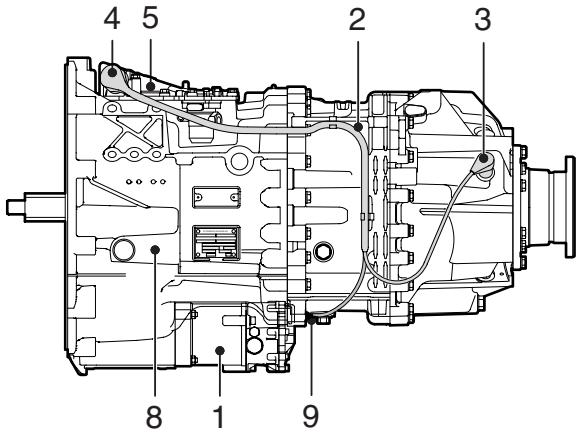
1. Remove the bolts (1) from the clutch inspection cover (2) and remove the clutch inspection cover.
2. Remove the connector (4) on the left-hand side of the gearbox modulator and the speed sensor connector (3).
3. Bleed circuit 4 and remove the air pipe from the clutch unit.
4. Remove the attachment nuts (3) from the clutch unit (5) and remove the complete clutch unit, including the wiring harness.
5. Remove the thrust pin from the clutch lever.



V300669

Installing the clutch unit

1. Fit the thrust pin in the clutch lever.
2. Bleed the clutch unit.
3. Fit the clutch unit, tighten the attachment bolts. See “Technical data”.
4. Fit the air pipe, tighten the attachment bolts. See “Technical data”.
5. Fit the wiring harness (2), with connector 4 to the modulator (5) and connector 3 to the speed sensor.
6. Fit the clutch inspection cover.



V300718

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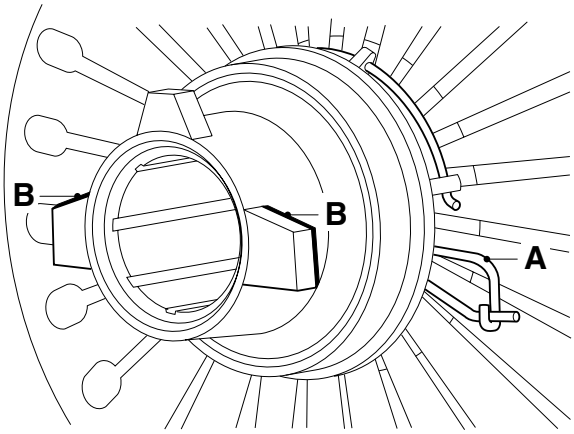
5.3 REMOVAL AND INSTALLATION, PULL-TYPE CLUTCH THRUST BEARING

Removing the pull-type clutch thrust bearing

1. Remove the gearbox.
2. Remove the thrust bearing from the clutch release assembly by releasing the retaining clip (A) from the clutch release assembly.



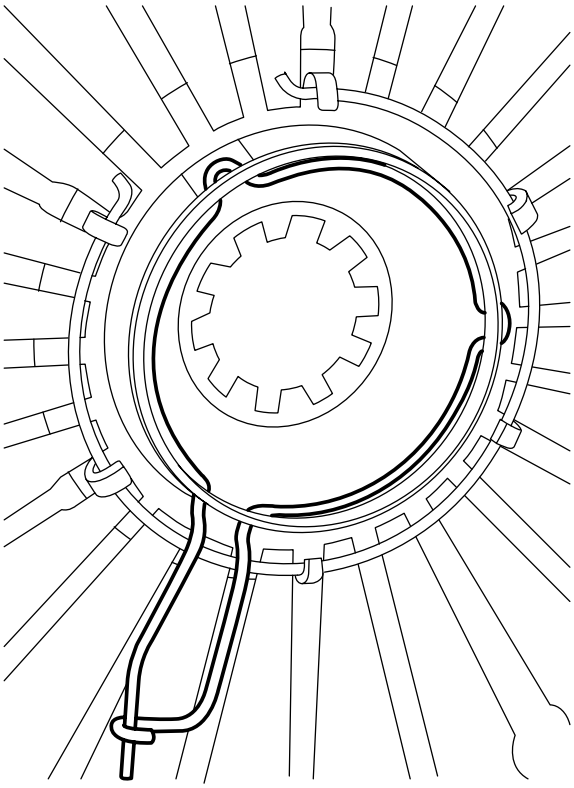
V300059

Installing the pull-type clutch thrust bearing

In the case of thrust bearings with a plastic coating, no grease should be used on the gearbox front cover. The grease will attack the plastic coating and shorten the service life of the thrust bearing.
The thrust bearing chamber has been greased for the full service life.

1. Apply a little grease to the pressure surfaces of the release fork and the thrust washer.
2. Fit the thrust bearing, with the lip pointing up, **dry** onto the gearbox front cover.
3. Move the clutch lever, causing the thrust bearing to engage behind the rolls of the clutch lever.

   Note:
   Before fitting the gearbox, check whether the retaining clip in the clutch release assembly has been locked.


V300123

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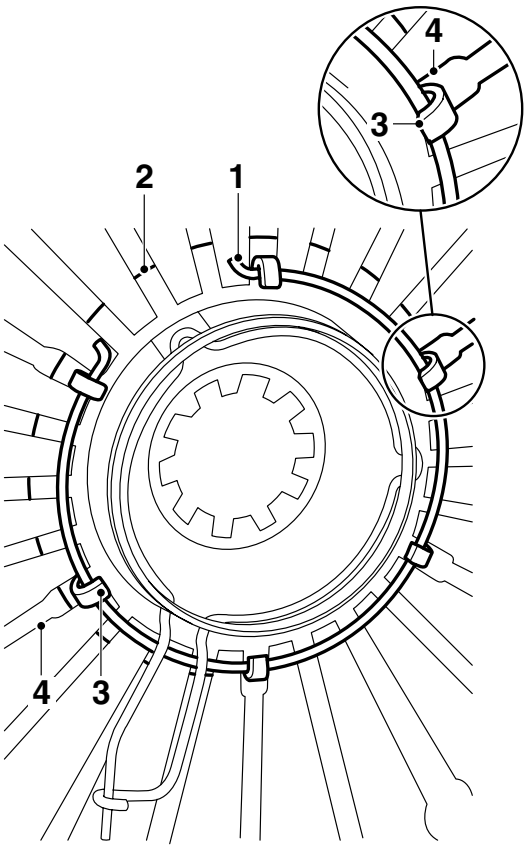
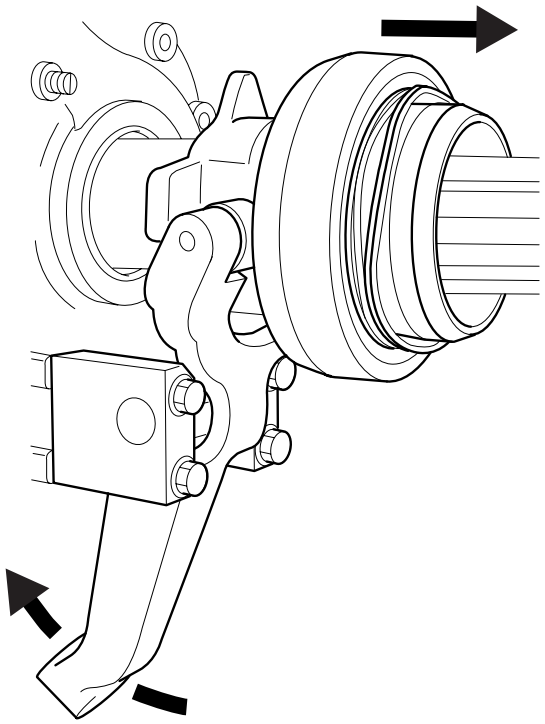
4. Check whether the retainer plate (2) and circlip (1) and retaining clip (3) have been fitted in the correct locations. The diaphragm springs (4) have special recesses to accommodate the retaining clips (3).



V300122

5. Fit the gearbox.
6. Move the clutch lever so as to lock the thrust bearing in the clutch release assembly.


V300442

5.4 REMOVAL AND INSTALLATION, PUSH-TYPE CLUTCH THRUST BEARING

Removing the push-type clutch thrust bearing

1. Remove the gearbox.
2. Remove the thrust bearing from the clutch lever in the clutch housing. If fitted, remove the locking bolt (1).

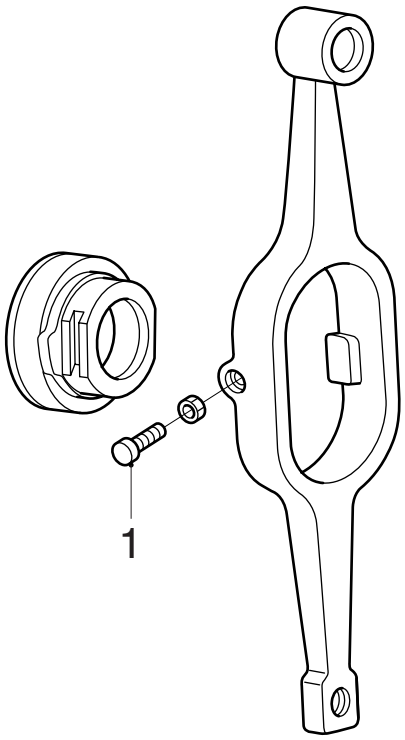
Note:
This applies only to the fork of the *CF*75.
The fork of the *CF*65 does not have a locking bolt.

Installing the push-type clutch thrust bearing

In the case of thrust bearings with a plastic coating, no grease should be used on the gearbox front cover. The grease will attack the plastic coating and shorten the service life of the thrust bearing.

1. Apply a little grease to the pressure surfaces of the release fork and the thrust washer.
2. In the case of thrust bearings with an aluminium lining, apply a little grease to the gearbox front cover.
3. Install the thrust bearing onto the clutch lever and install the locking bolt (1), if present.

   Note:
   When tightening the locking bolt (1) in the thrust bearing groove, ensure that the thrust bearing can move freely relative to the clutch lever.
4. Fit the gearbox.



V300291

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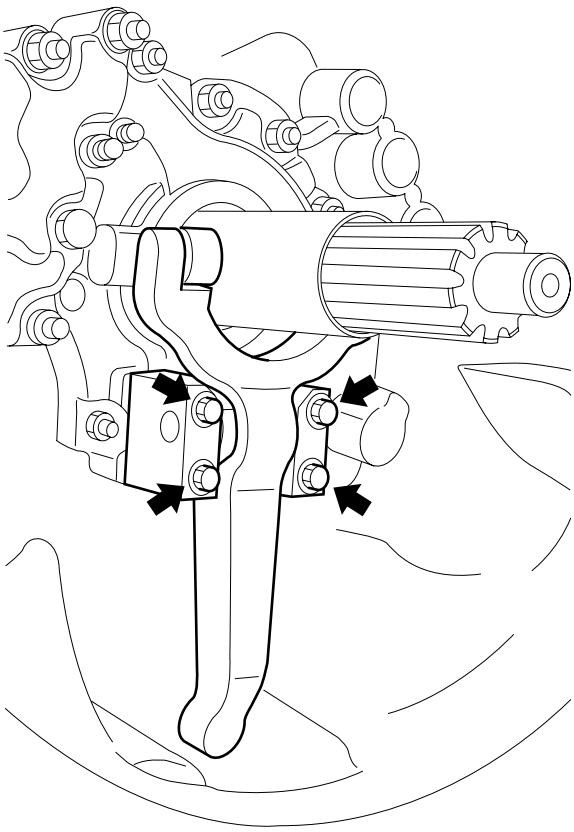
5.5 REMOVAL AND INSTALLATION, PULL-TYPE CLUTCH LEVER

Removing the pull-type clutch lever

1. Remove the gearbox.
2. Remove the thrust bearing.
3. Remove the attachment bolts from the clutch lever.

Installing the pull-type clutch lever

1. Apply a little grease to the moving parts of the clutch lever.
2. Install the clutch lever on the gearbox and tighten the attachment bolts.
3. Fit the thrust bearing.
4. Fit the gearbox.



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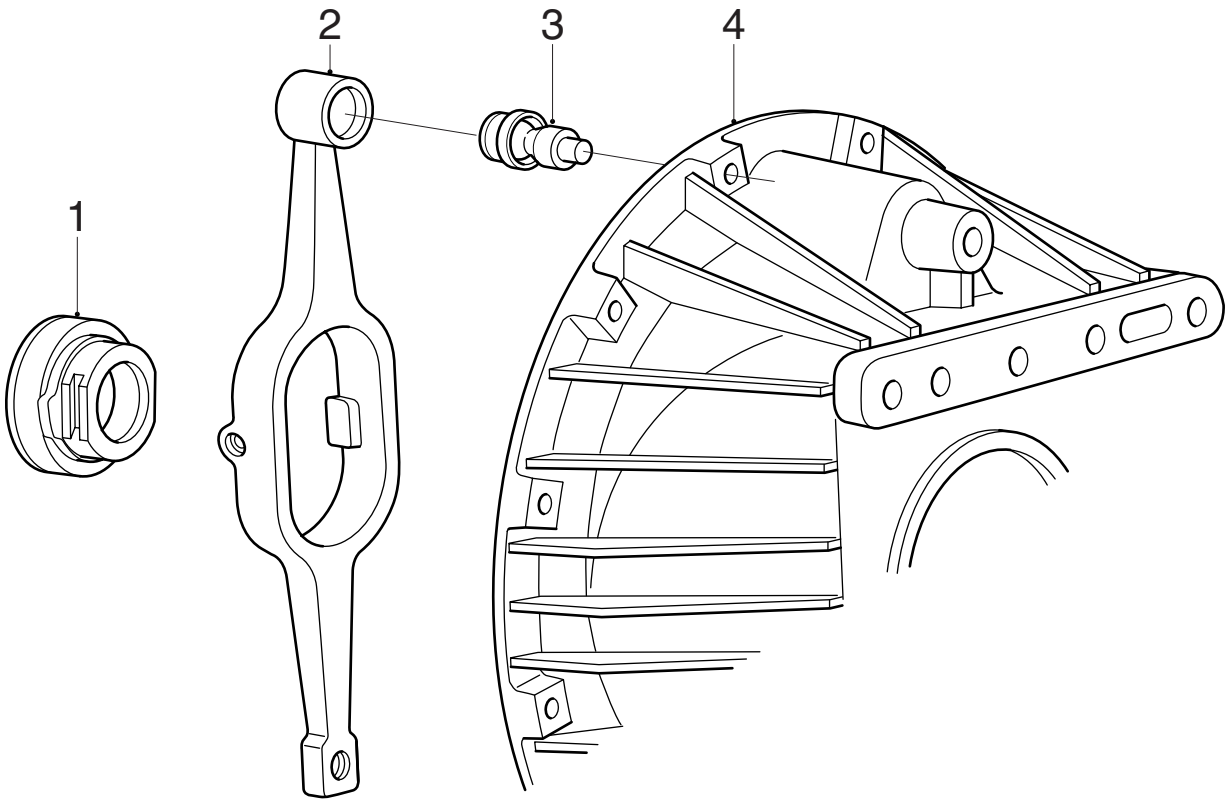
5.6 REMOVAL AND INSTALLATION, PUSH-TYPE CLUTCH LEVER



Removing the push-type clutch lever

1. Remove the gearbox.
2. Remove the thrust bearing.
3. Force the clutch lever (2) out of the ball joint (3) fitted in the clutch housing (4).

Installing the push-type clutch lever

1. Apply a little grease to the moving parts of the clutch lever.
2. Force the clutch lever (2) into the ball joint (3) fitted in the clutch housing (4).
3. Fit the thrust bearing.
4. Fit the gearbox.

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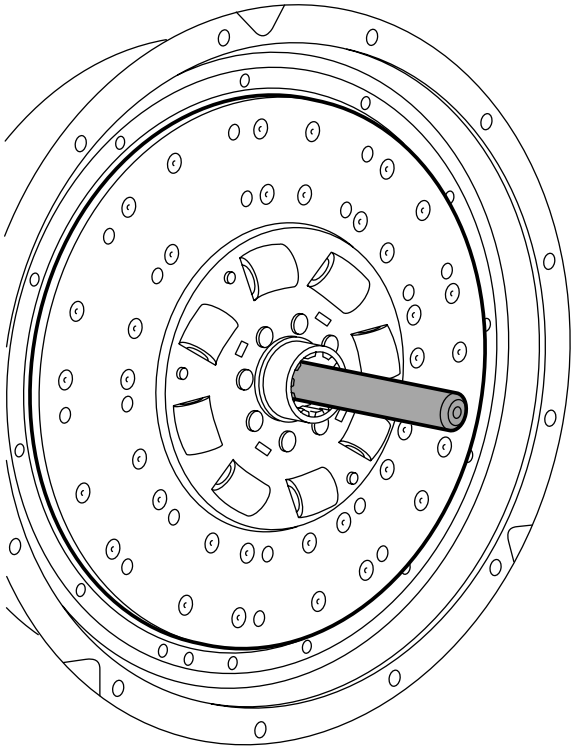
5.7 REMOVAL AND INSTALLATION, CLUTCH RELEASE ASSEMBLY/CLUTCH PLATE

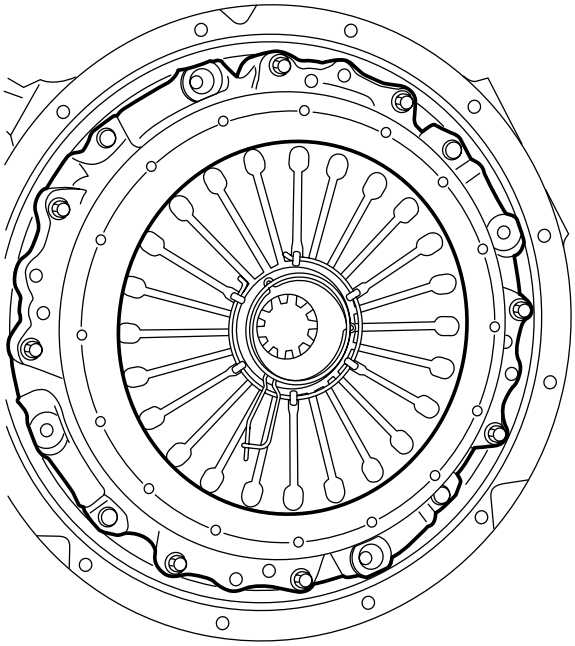
Removing the clutch release assembly/clutch plate

1. Remove the gearbox.
2. If necessary, remove the thrust bearing.
3. Insert a dummy input shaft through the hub of the clutch plate in the flywheel pilot bearing.



V300124

4. Remove four attachment bolts distributed around the circumference from the clutch release assembly and replace them with studs.
5. Evenly remove the remaining attachment bolts from the clutch release assembly.
6. Remove the clutch release assembly by sliding it off the four studs.
7. Remove the clutch plate with the dummy input shaft.



V300125

Installing the clutch release assembly/clutch plate

1. Apply a little grease to the input shaft and check the movement of the clutch plate on the splines of the input shaft.
2. Use a dummy input shaft to position the clutch plate against the flywheel.
3. Install four studs in the flywheel, distributed evenly around the circumference.
4. Support the clutch release assembly and slide it onto the four studs.
5. Fit the attachment bolts and tighten them crosswise and evenly to the specified torque. See “Technical data”.
6. Apply a little grease to all pivoting points of the release fork.
7. If necessary, fit the thrust bearing.
8. Fit the gearbox.

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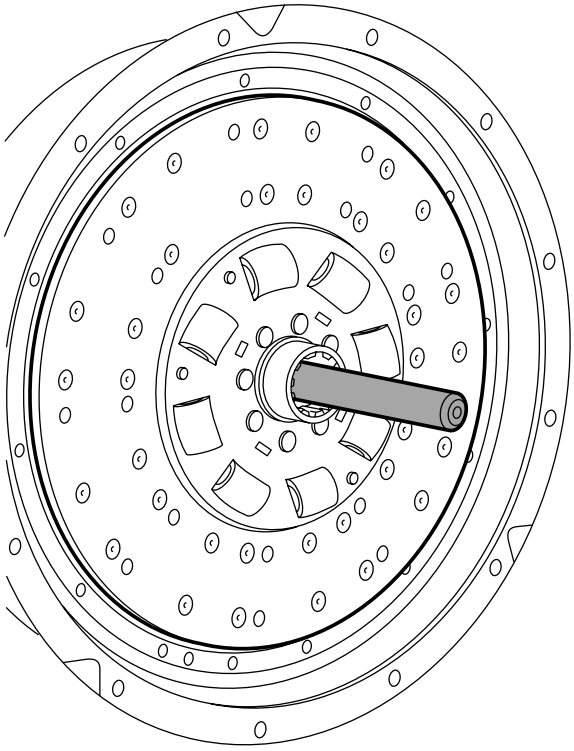
5.8 REMOVAL AND INSTALLATION, AUTOMATICALLY ADJUSTING CLUTCH RELEASE ASSEMBLY/CLUTCH PLATE

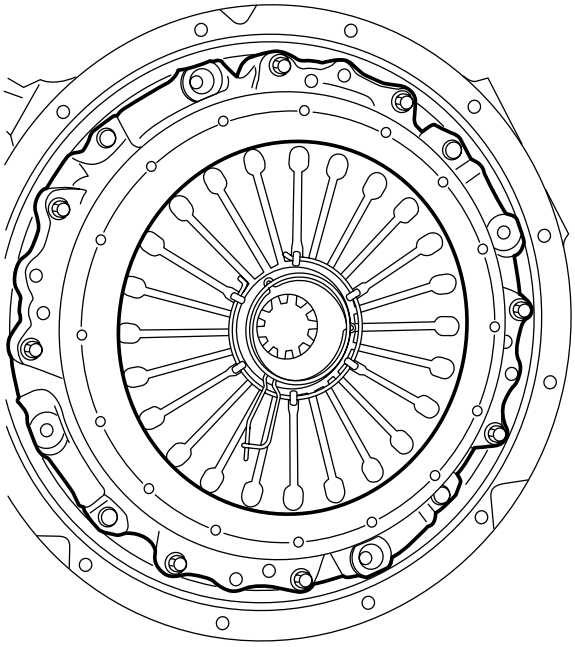
Removing the automatically adjusting clutch release assembly/clutch plate

1. Remove the gearbox.
2. If necessary, remove the thrust bearing.
3. Insert a dummy input shaft through the hub of the clutch plate in the flywheel pilot bearing.



V300124

4. Remove four attachment bolts distributed around the circumference from the clutch release assembly and replace them with studs.

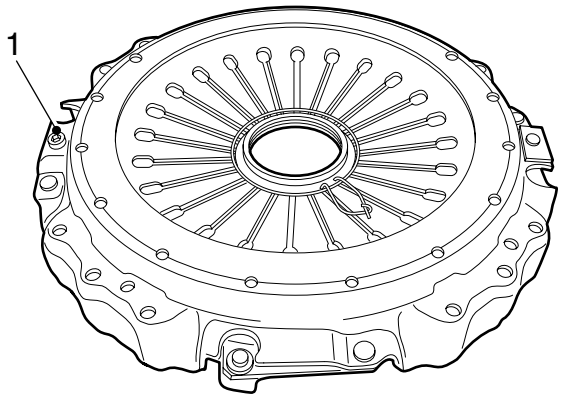


V300125

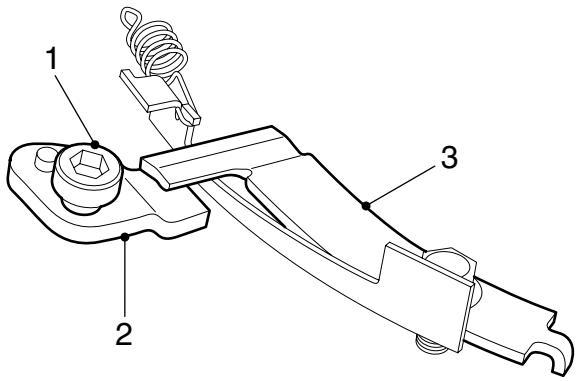
Note:
If you want to disassemble the entire clutch assembly, always loosen the attachment bolt (1) of the stop plate (2) first before removing the clutch release assembly.

If you do **not** loosen the attachment bolt (1) of the stop plate (2) before removing the clutch release assembly, the stop spring (3) will be deformed.

5. Fully loosen the attachment bolt (1) of the stop plate (2).
6. Evenly remove the remaining attachment bolts from the clutch release assembly.
7. Remove the clutch release assembly by sliding it off the four studs.
8. Remove the clutch plate with the dummy input shaft.



V300473



V300474

Installation of an existing automatically adjusting clutch release assembly/clutch plate

1. Apply a little grease to the input shaft and check the movement of the clutch plate on the splines of the input shaft.
2. Use a dummy input shaft to position the clutch plate against the flywheel.
3. Install four studs in the flywheel, distributed evenly around the circumference.

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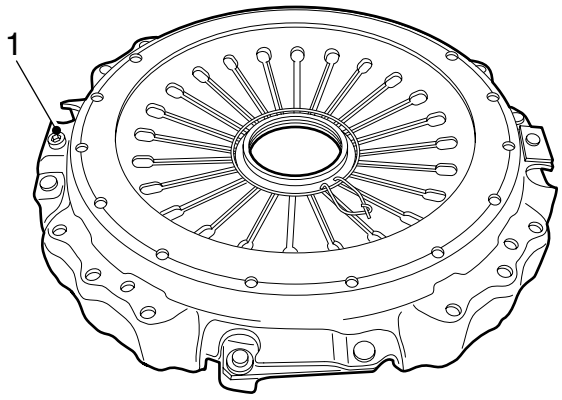
Note:
When refitting an existing clutch release assembly and clutch plate, the attachment bolt (1) of the stop plate (2) must be loosened before removing the clutch release assembly. This prevents deformation of the stop spring (3). A deformed stop spring (3) will deflect the automatically adjusting assembly to its maximum extent, causing it to stop working properly. If this happens you will have to replace the clutch release assembly complete with clutch plate. The automatically adjusting assembly **cannot** be reset manually.

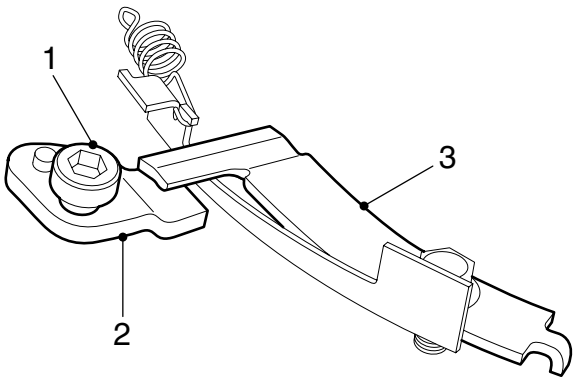


V300473

4. Fit the clutch release assembly, with the stop plate (2) loosened, onto the flywheel.
5. Fit the attachment bolts and tighten them crosswise and evenly to the specified torque. See “Technical data”.

   Note:
   Ensure that the stop plate (2) is positioned **below** the stop spring (3) before you tighten the attachment bolt (1).

   This will prevent deformation of the stop spring.



V300474

6. Apply locking compound to the attachment bolt (1) and tighten the bolt to the specified torque. See “Technical data”.
7. Apply a little grease to all pivoting points of the release fork.
8. If necessary, fit the thrust bearing.
9. Fit the gearbox.

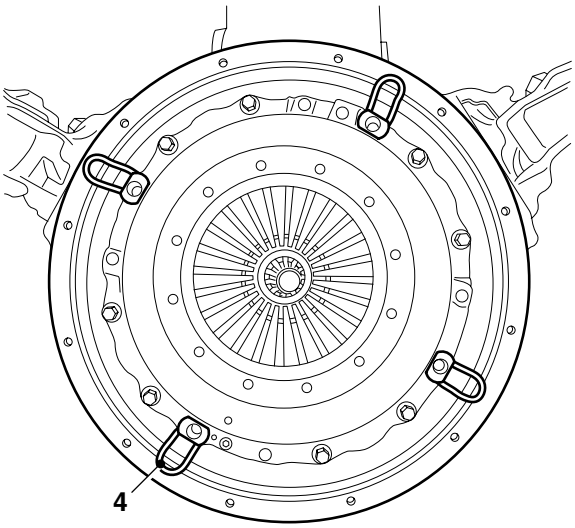
10

Installation of a new automatically adjusting clutch release assembly/clutch plate

Note:
The automatically adjusting clutch release assemblies have a transport mechanism. This transport mechanism prevents deformation of the stop spring in the clutch release assembly that might occur during transport. Be sure to remove the clamps of the transport mechanism after installation of the clutch release assembly. After installation of the clutch release assembly the clamps will hang loose, so that they can be moved to the exterior of the clutch release assembly.

1. Apply a little grease to the input shaft and check the movement of the clutch plate on the splines of the input shaft.
2. Use a dummy input shaft to position the clutch plate against the flywheel.
3. Install four studs in the flywheel, distributed evenly around the circumference.

   Note:
   You do **not** have to loosen the attachment bolt (1) of the stop plate (2) first when fitting a **new** clutch release assembly. A new clutch release assembly must also always be fitted with a new clutch plate.
4. Fit the clutch release assembly onto the flywheel.
5. Fit the attachment bolts and tighten them crosswise and evenly to the specified torque. See “Technical data”.
6. Apply a little grease to all pivoting points of the release fork.
7. If necessary, fit the thrust bearing.
8. Fit the gearbox.



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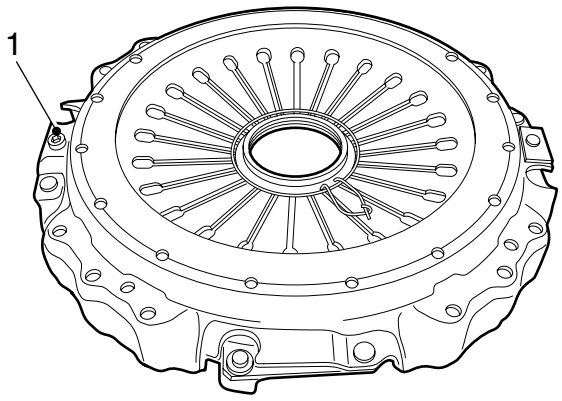

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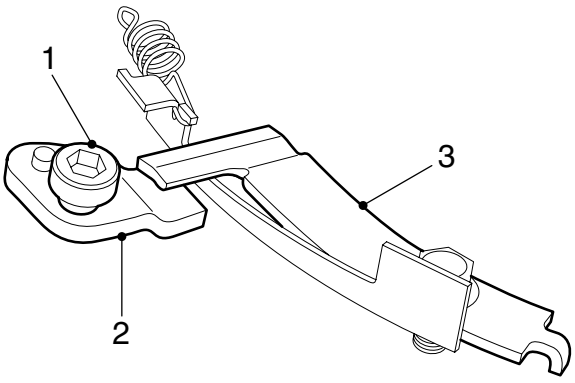

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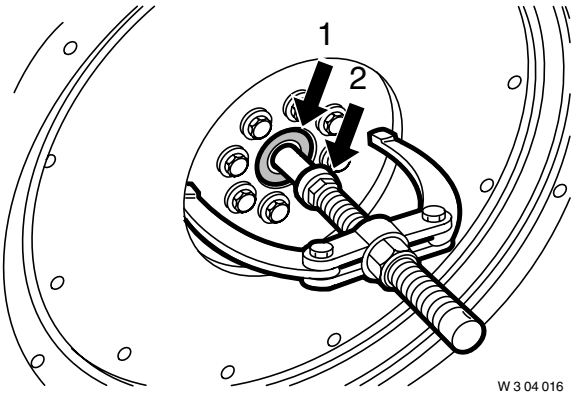
5.9 REMOVAL AND INSTALLATION, PILOT BEARING

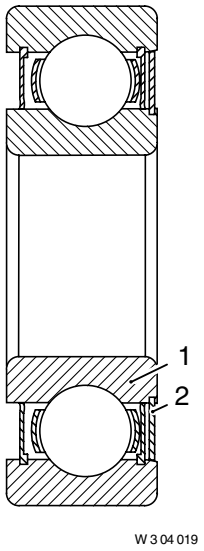
Removing the pilot bearing

1. Remove the gearbox.
2. Remove the clutch release assembly and the clutch plate.
3. Use an internal puller (2) to remove the pilot bearing (1) from the flywheel.

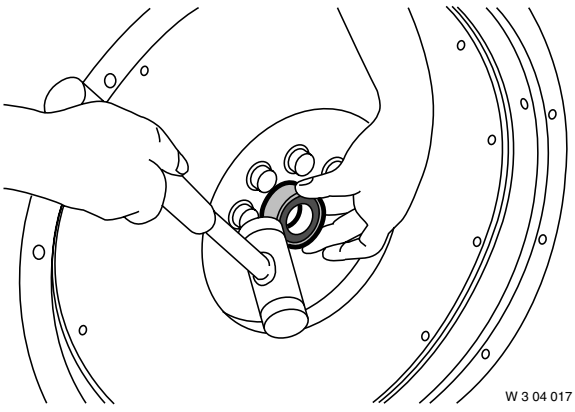


Fitting the pilot bearing

1. Check the flywheel bore for dirt and damage.
2. **Note:**
   The pilot bearing (1) has a grease and dust seal (2) on one side only. When the pilot bearing is fitted, the grease and dust seal must be on the clutch plate side.



3. Use a plastic mallet to fit the bearing in the flywheel.
4. Fit the clutch release assembly and the clutch plate.
5. Fit the gearbox.



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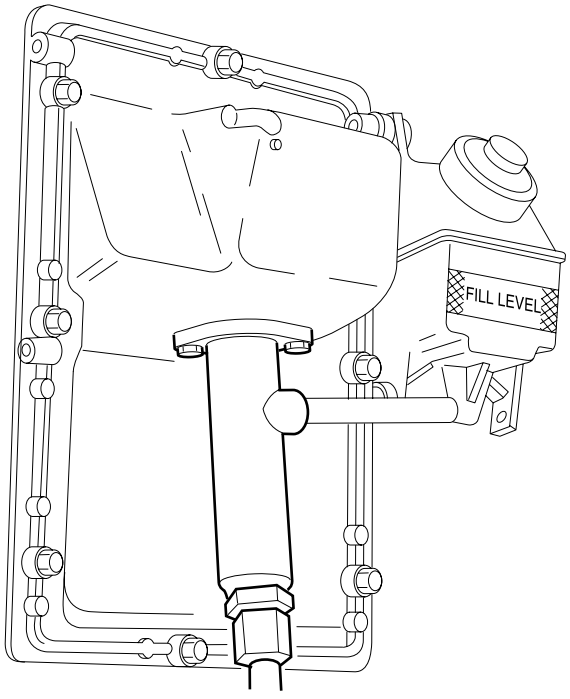
5.10 REMOVAL AND INSTALLATION, MAIN CYLINDER

Hydraulic fluid is toxic and can therefore have a damaging effect on your health.Hence avoid any direct or indirect physical contact. As hydraulic fluid is also a corrosive fluid, it may damage the paintwork of the vehicle. Avoid any contact between hydraulic fluid and paintwork.

Always use new and clean hydraulic fluid which has been kept in a sealed container that meets the specifications. Hydraulic fluid which has absorbed water (from the ambient air) may have an adverse effect on the operation of the clutch system.
Avoid any contact with mineral oil. Even one drop of mineral oil in the system will damage the seals.

Removing the main cylinder

1. Connect a transparent plastic hose to the clutch servo's bleed nipple.
2. Open the bleed nipple (collect the fluid) and drain the system.
3. Remove the clutch spring from the clutch pedal.
4. Remove the attachment bolt from the clutch pedal and the main cylinder.
5. Remove the pipe between the reservoir and the main cylinder.
6. Disconnect the fluid pipe at the bottom of the main cylinder.
7. Remove the two attachment bolts from the main cylinder and take the cylinder from the bracket.



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Installing the main cylinder

1. Check the dust cover for wear and replace if necessary.
2. Fit the main cylinder together with the pipe to the reservoir.
3. Fit the clutch pipe.
4. Fit the main cylinder attachment bolts to the bracket and tighten them.
5. Fit the dust cover in the thrust pin circlip.
6. Fit the clutch pedal attachment bolt and the main cylinder.
7. Fit the clutch spring onto the clutch pedal.
8. Fit the clutch pipe clamping bracket bolt underneath the main cylinder.
9. Fill the clutch system. See “Draining and filling”.
10. Adjust the clutch pedal. See “Inspection and adjustment”.
11. Bleed the clutch system. See “Bleeding the clutch system”.

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6. DRAINING AND FILLING

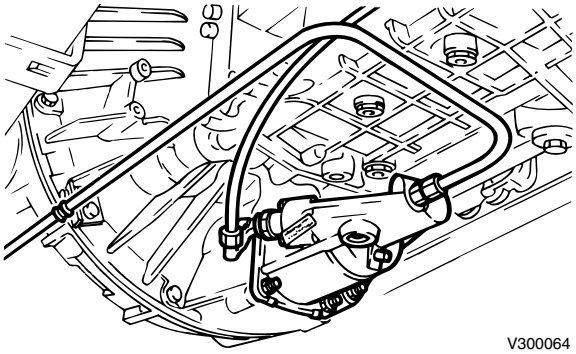
6.1 DRAINING AND FILLING, CLUTCH SYSTEM

Hydraulic fluid is toxic and can have a damaging effect on your health. Direct or indirect physical contact should therefore be avoided.
As hydraulic fluid is also a corrosive fluid, it may damage the paintwork of the vehicle. Avoid any contact between hydraulic fluid and paintwork.

Always use new and clean hydraulic fluid which has been kept in a sealed container that meets the specifications. Hydraulic fluid which has absorbed water (from the ambient air) may have an adverse effect on the operation of the clutch system.
Avoid any contact with mineral oil. Even one drop of mineral oil in the system will damage the seals.

Draining the clutch system
1. Place a tray beneath the clutch servo.
2. Disconnect the steel supply pipe from the clutch servo and drain the oil from the reservoir by moving the pedal up and down.
3. Refit the steel supply pipe.

Filling the clutch system
1. Fill the reservoir with the specified fluid and bleed the system.



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6.2 BLEEDING THE CLUTCH SYSTEM

Hydraulic fluid is toxic and can have a damaging effect on your health. Direct or indirect physical contact should therefore be avoided.
As hydraulic fluid is also a corrosive fluid, it may damage the paintwork of the vehicle. Avoid any contact between hydraulic fluid and paintwork.

Always use new and clean hydraulic fluid which has been kept in a sealed container that meets the specifications.
Hydraulic fluid which has absorbed water (from the ambient air) may have an adverse effect on the operation of the clutch system.
Avoid any contact with mineral oil. Even one drop of mineral oil in the system will damage the seals.

Bleeding the clutch system using the "servo" bleed tank

1. Connect the "servo" bleed tank to the reservoir.
2. **Note:**
   Filling too quickly causes foaming, which makes bleeding virtually impossible.

   Fill the system via the "servo" bleed tank.
3. Connect a transparent pipe to the clutch servo's bleed nipple.
   Insert the pipe into a jar.
4. Open the bleed nipple two full turns.
   As soon as no more air bubbles escape from the transparent pipe, the bleed nipple can be closed again.
5. Check the fluid level. See "Inspection and adjustment".

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Bleeding the clutch system by operating the clutch pedal

1. Connect a transparent pipe to the clutch servo's bleed nipple.
   Insert the pipe into a jar filled with the specified fluid. Ensure that the end is below the fluid level.

2. Open the bleed nipple.

3. Gradually depress the clutch pedal and close the bleed nipple. Gradually release the clutch pedal.
   Repeat this operation. The fluid in the reservoir should be topped up continually.

4. Pump the clutch pedal again and top up the fluid until no more air bubbles escape through the transparent pipe.

5. Check the fluid level. See "Inspection and adjustment".

Bleeding the clutch system via the clutch servo

1. **Note:**
   Sometimes it may be difficult to bleed the clutch system. In such cases, the clutch system can also be bled using a priming pump and the bleed nipple on the clutch servo.
   Ensure that the priming pump is thoroughly cleaned inside.

   Connect a transparent pipe to a priming pump (e.g. oil can) and fill the pump with the specified fluid.

2. Continue pumping until fluid without air bubbles flows from the pipe.

3. Then connect the pipe to the bleed nipple of the clutch servo and open the bleed nipple.

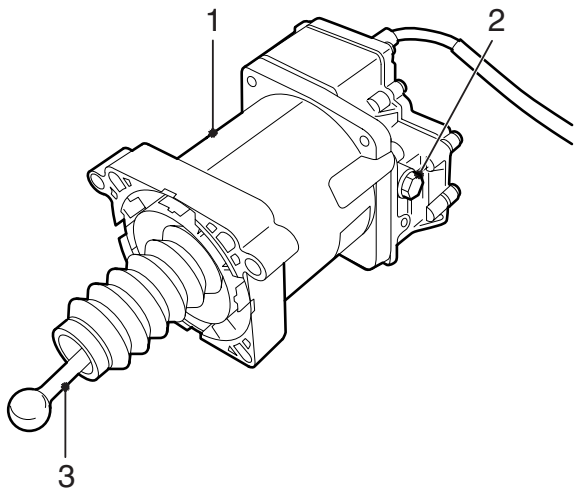
4. Pump the fluid into the system with the priming pump.
   In doing so, observe the following:
   - Do not depress the clutch pedal.
   - Make sure that no air bubbles are introduced into the system.
   - Monitor the fluid level in the priming pump.
   - Monitor the fluid level in the clutch reservoir.

10

6.3 BLEEDING AS TRONIC CLUTCH UNIT

Note:
The clutch unit must be bled before it is installed, to prevent it from being installed under tension.

1. Undo the bleed screw (2) of the clutch unit (1).
2. Push the control rod (3) inwards and tighten the bleed screw while the control rod is depressed. See “Technical data”.



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CONTENTS

		Page	Date
1.	**GENERAL**	1-1	0111
1.1	Overview drawing, prop shaft	1-1	0111
1.2	Overview drawing, centre bearing	1-2	0111
2.	**INSPECTION AND ADJUSTMENT**	2-1	0111
2.1	Inspection, prop shaft	2-1	0111
3.	**REMOVAL AND INSTALLATION**	3-1	0111
3.1	Removal and installation, prop shaft/auxiliary shaft assembly	3-1	0111
4.	**DISASSEMBLY AND ASSEMBLY**	4-1	0111
4.1	Disassembly and assembly, universal joint	4-1	0111
4.2	Disassembly and assembly, centre bearing	4-5	0111
5.	**LUBRICATION**	5-1	0111
5.1	Lubrication, prop shaft and auxiliary shaft	5-1	0111

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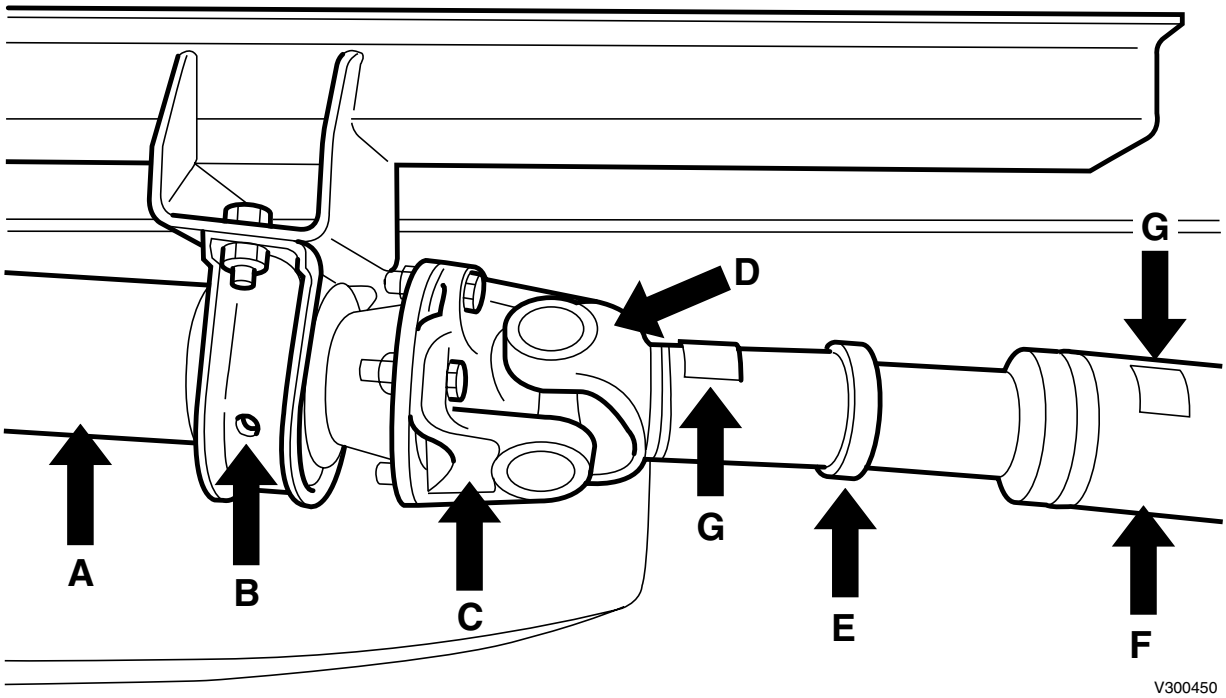
1. GENERAL

1.1 OVERVIEW DRAWING, PROP SHAFT



A Intermediate shaft
B Centre bearing
C Drive flange
D Fork
E Slide joint
F Prop shaft
G Balancing plates

For the CF65/75/85 vehicle series, DAF has one manufacturer of prop shafts, Klein.
Klein shafts can be identified by their highly bevelled flanges.

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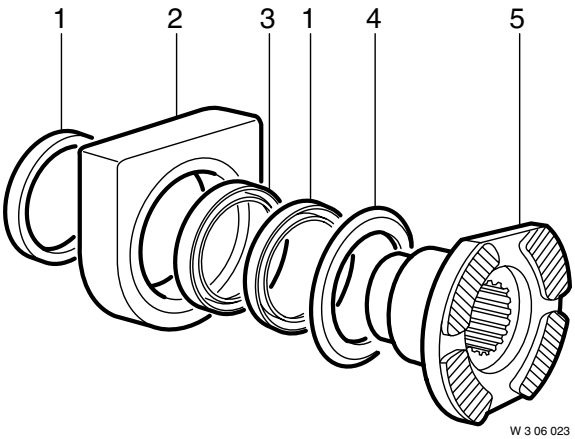
1.2 OVERVIEW DRAWING, CENTRE BEARING

1. Sealing ring
2. Rubber block
3. Bearing
4. Dust cover
5. Flange



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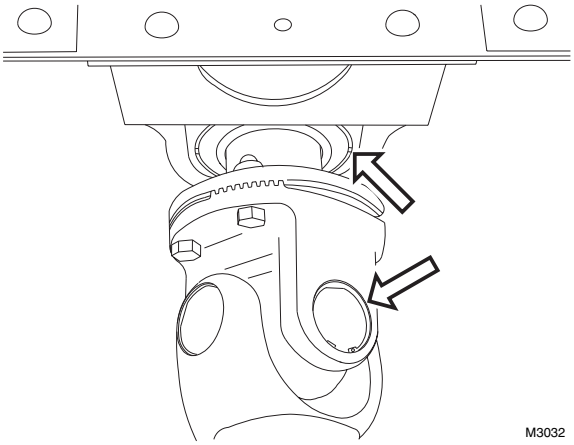
2. INSPECTION AND ADJUSTMENT

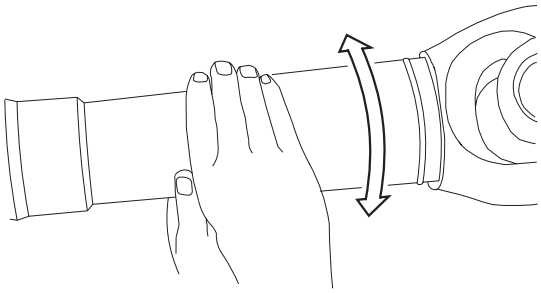
2.1 INSPECTION, PROP SHAFT

1. Check the universal joints and centre bearing for play and damage.



M3032

2. Check the slide coupling for radial play.



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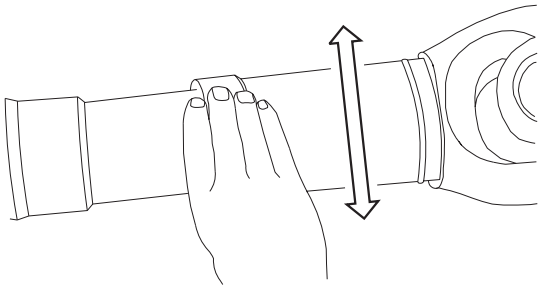
3. There must be no clearly noticeable play on universal joints and centre bearing.



M3020

4. Now check the slide coupling radial play manually.

   If radial play is found in the slide coupling, first make sure that the play does not come from the universal joints. In order to ensure that the play noticed lies within the maximum permissible tolerance, remove and check the prop shaft.

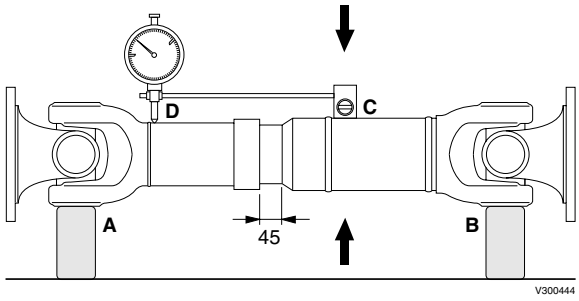
5. Place the removed prop shaft on a flat working bench and support the shaft at positions A and B.

6. Push the slide coupling around 45 mm outwards.

7. Position the universal measuring tool on the fitted prop shaft at position C.

8. Place the dial gauge at position D on the prop shaft (next to the welding joint).

9. Move the prop shaft up in the centre of gravity (see arrows) and measure the radial play of the slide coupling.
   For the maximum permissible play, see “Technical data”.



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3. REMOVAL AND INSTALLATION

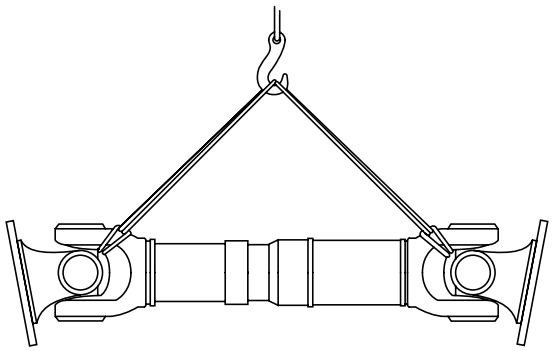
3.1 REMOVAL AND INSTALLATION, PROP SHAFT/AUXILIARY SHAFT ASSEMBLY

Removal, prop shaft/intermediate shaft assembly

1. When removing one of the shafts in vehicles with multiple shafts (prop shaft and auxiliary shafts), the other shaft must be tied to the chassis or intermediate beam in such a way that it does not obstruct the various activities.

2. **Note:**
   Always transport and store shafts horizontally to avoid damage and subsequent imbalance.
   Support the shaft in at least two places. If possible, hang the shaft in a hoist, using two sturdy ropes.

   Remove the attachment bolts from the flanges and carefully lower the shaft to the ground.
   Now remove the shaft from under the vehicle.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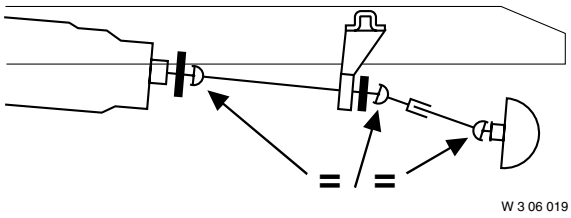
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Installation, prop shaft/intermediate shaft assembly

1. **Note:**
   After repairs have been carried out or a shaft has been replaced, the marks on the shafts must be opposite each other.

   Fit the shaft under the vehicle. Use a hoist if possible.

2. Tighten the attachment bolts to the specified tightening torque. See “Technical data”.

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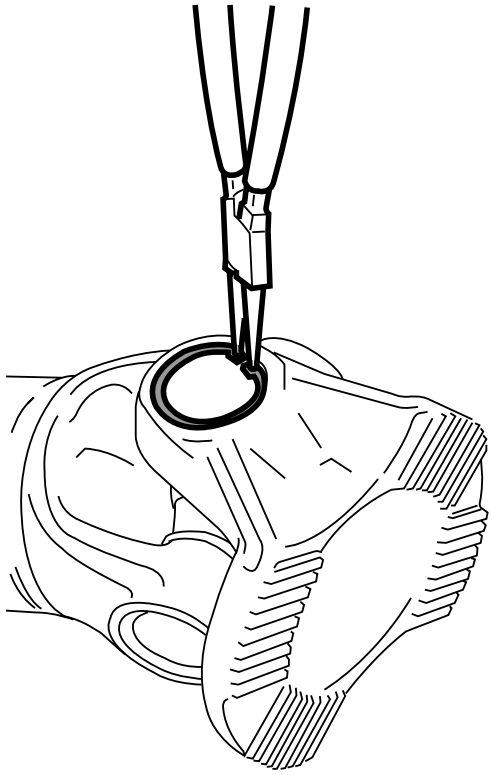
4. DISASSEMBLY AND ASSEMBLY

4.1 DISASSEMBLY AND ASSEMBLY, UNIVERSAL JOINT

Disassembly, universal joint

1. Remove the entire prop shaft and/or intermediate shaft.
2. If fitted, remove the lubricating nipple and all Seeger rings from the spider to be replaced.



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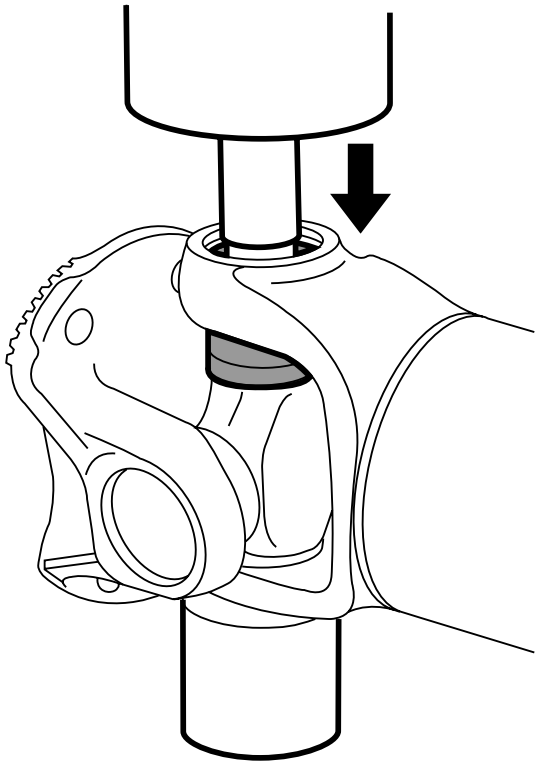
3. Place the shaft on a bush underneath a press, as shown, and press the entire spider including bearings and drive flange down until the spider touches the fork of the shaft.



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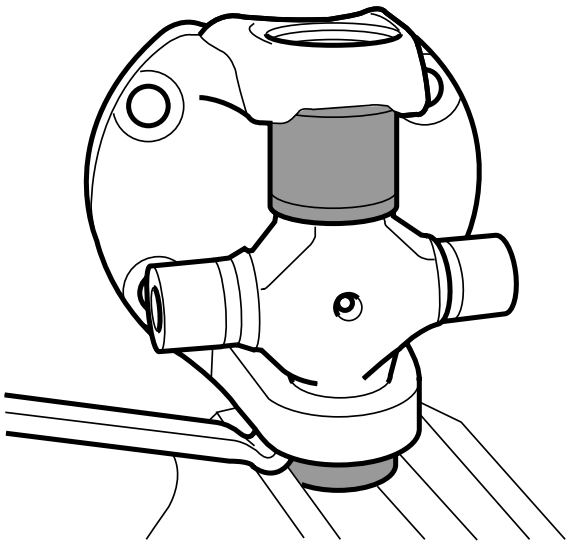
4. Rotate the shaft 180° and remove the bearing that has just been pressed out. If the first bearing to be removed fails to come out of the fork entirely, the bearing can be clamped to enable the fork to be pushed up by means of a lever. Place the shaft back on to the bush.



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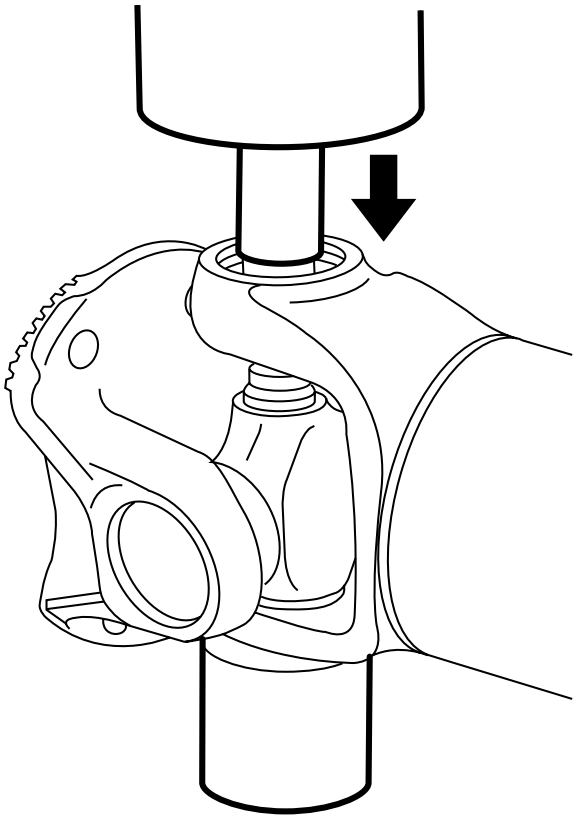
5. Push the spider down again in the direction of the shaft fork. Again, continue until the spider touches the fork.
6. The spider and the drive flange can now be tilted from the shaft fork.
7. Place the drive flange on a bush underneath a press and press the entire spider including bearings and drive flange down, until the spider touches the fork of the drive flange.
8. Rotate the drive flange 180° and remove the bearing that has just been pressed out. Place the drive flange back on the bush.
9. Push the spider down again in the direction of the shaft fork. Again, continue until the spider touches the fork.
10. The spider can now be tilted from the drive flange fork.
11. **Note:**
    When spiders are being replaced, always replace them including their bearings. Check the components to be reused for any cracks and/or damage.



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Assembly, universal joint

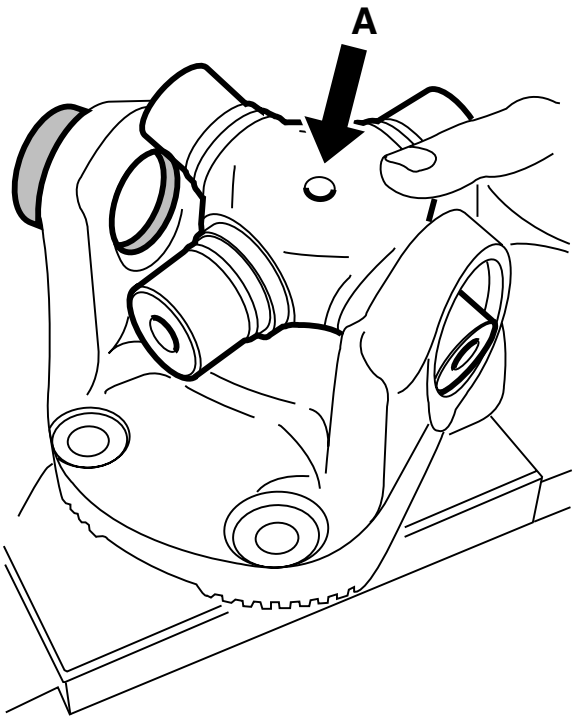
1. **Note:**
   After installation, it must be possible to move the drive flanges and spiders by hand. When mounting the spider, Seeger rings of the same thickness must be used.

   Install the sealing rings in their proper positions on the bearings and lubricate them lightly so that the needles remain in place.

2. Press one bearing partly into the drive flange.

3. Tilt the spider in the drive flange.

   Note:
   Maintenance-free spiders do not have an assembly direction. In the case of spiders fitted with lubricating nipples, hole A for the lubricating nipple must point towards the shaft.



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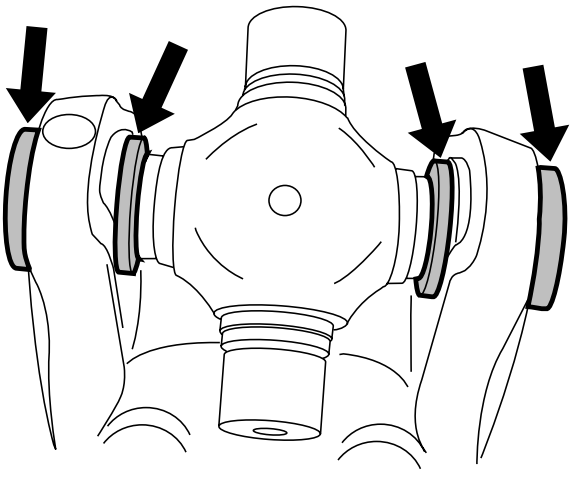
4. Slide the spider a little into the installed bearing and place everything onto a bush underneath a press. The opposite bearing can now be pressed into the fork, the spider serving as a guide. During the press action, the spider must be able to move freely.



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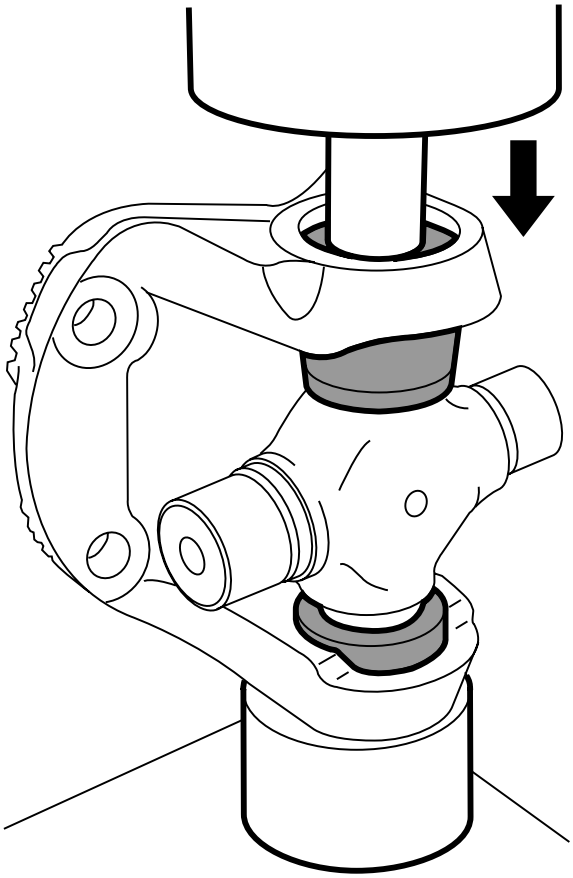
5. Continue to press the bearing until a Seeger ring can be installed on the side that is pressed. Install the Seeger ring and press the opposite bearing further into the fork. Then also install a Seeger ring here.
6. Install the sealing rings in their proper positions on the prop shaft bearings and lubricate them lightly so that the needles remain in place.
7. Press one bearing partly into the prop shaft.
8. Slide the spider a little into the installed bearing and place everything onto a bush underneath a press. The opposite bearing can now be pressed into the fork, the spider serving as a guide. During the press action, the spider must be able to move freely.
9. Continue to press the bearing until a Seeger ring can be installed on the side that is pressed. Install the Seeger ring and press the opposite bearing further into the fork. Then also install a Seeger ring here.
10. If fitted, install the lubricating nipple and lubricate the spider.
11. Install the prop shaft and/or intermediate shaft.



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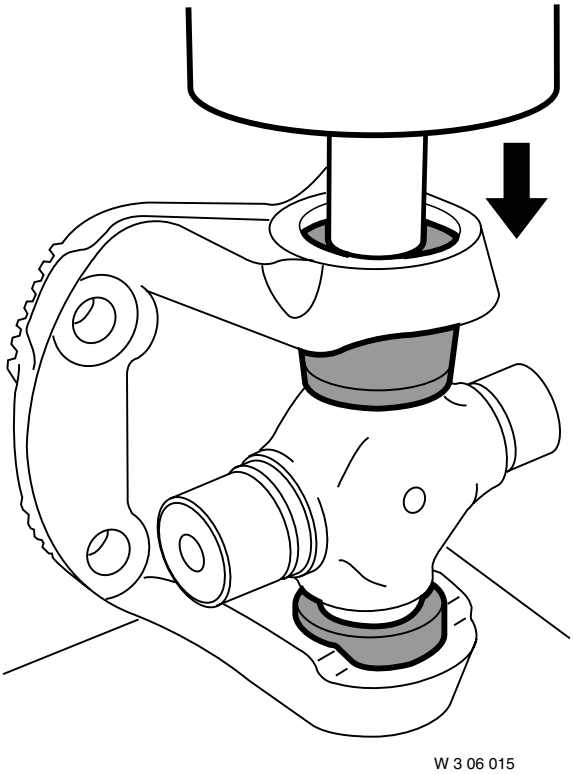

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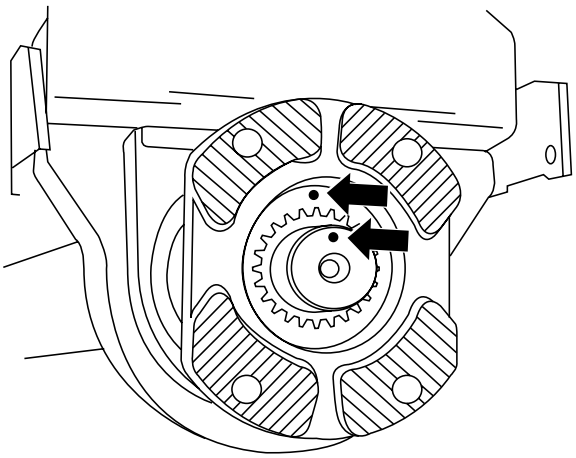
4.2 DISASSEMBLY AND ASSEMBLY, CENTRE BEARING

Disassembling the centre bearing

1. Hang the auxiliary shaft carefully on the chassis.
2. Remove the bolts that attach the flange to the prop shaft and the auxiliary shaft. Also secure the prop shaft carefully to the chassis.
3. Attach the special tool (DAF no. 0484977) to apply counter-pressure against the flange, and remove the central nut and the washer.
4. Mark the flange and shaft end with a centre point to ensure that the forks can all be fitted later in one line.
5. Remove the attachment bolts from the centre bearing and the chassis bracket.



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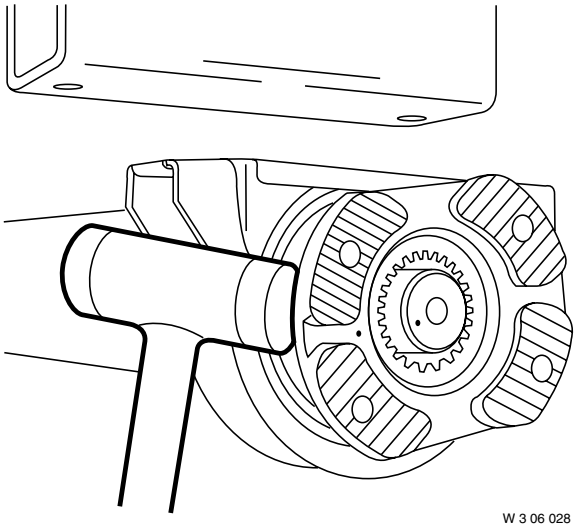
6. Use a plastic hammer to tap the flange and the centre bearing from the auxiliary shaft. If necessary, use a puller.



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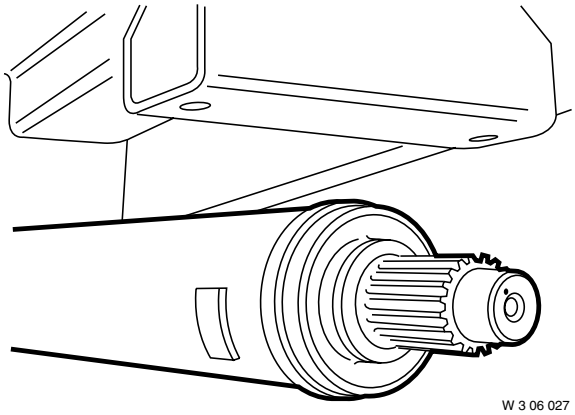

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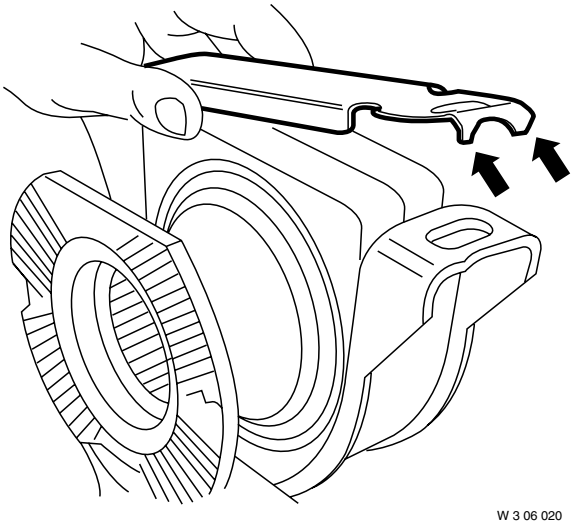
7. Remove the lock plate from the mounting bracket.



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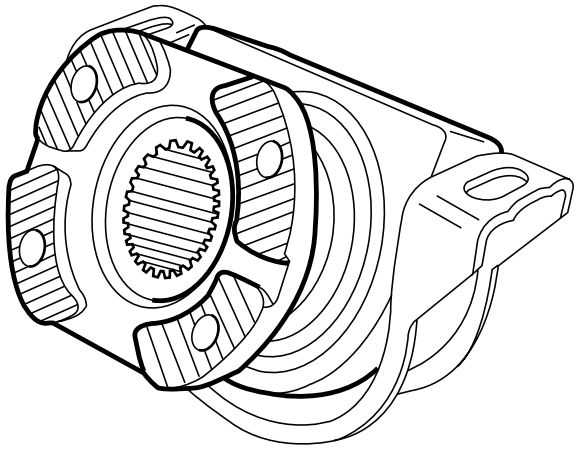
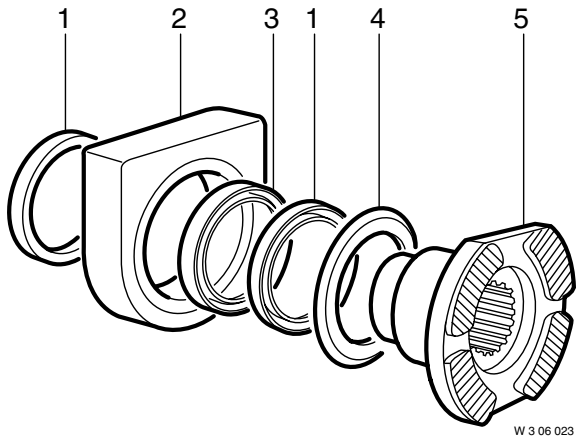
8. Unscrew the flange with bearing and rubber block (2) from the bracket.



W 3 06 022

9. Press the flange from underneath and press the bearing out.
10. Press the bearing with one sealing ring (1) out of the rubber block.
11. If necessary, remove the second sealing ring (1).

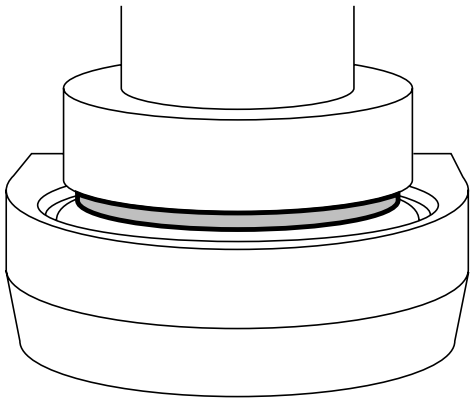
    Note:
    In case of damage, always replace the entire centre bearing.



W 3 06 023

Assembling the centre bearing

1. Press the sealing ring into the bush of the rubber block until it aligns with the outside of the bush.



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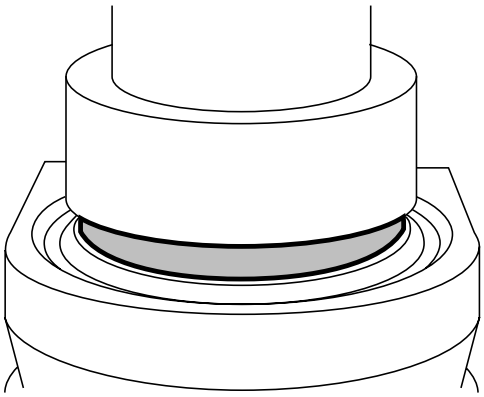

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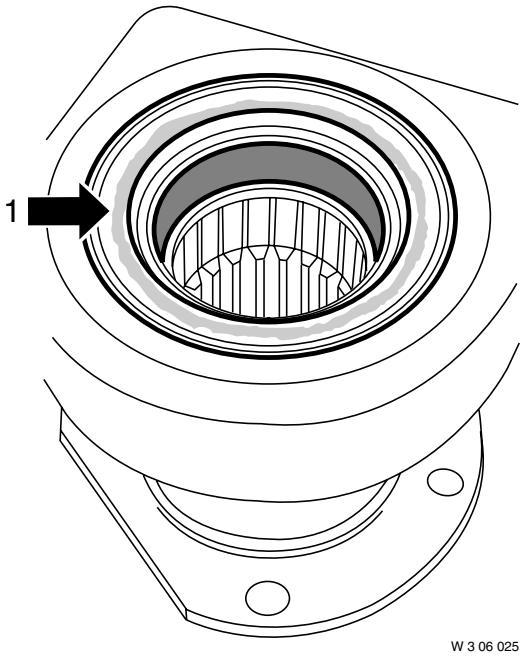
2. Press the bearing along the other side into the bush. Then the other sealing ring can be pressed into the bush. Apply grease to the sealing rings (1).



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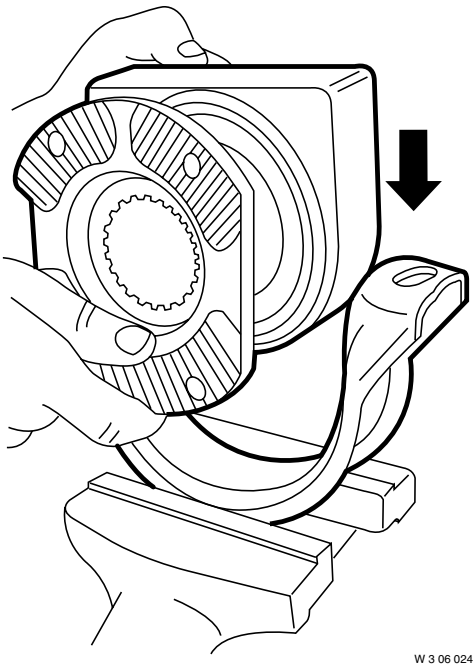
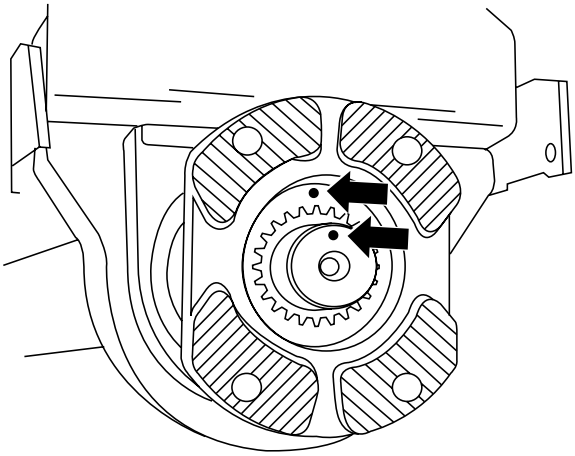
3. Press the assembly onto the flange, the larger space between bearing and sealing ring facing the flange.
4. Install the centre bearing assembly in the bracket and lock it with the lock plate.


W 3 06 024

5. Install the centre bearing onto the auxiliary shaft. Make sure that the centre points are aligned to ensure that later all forks are in one line.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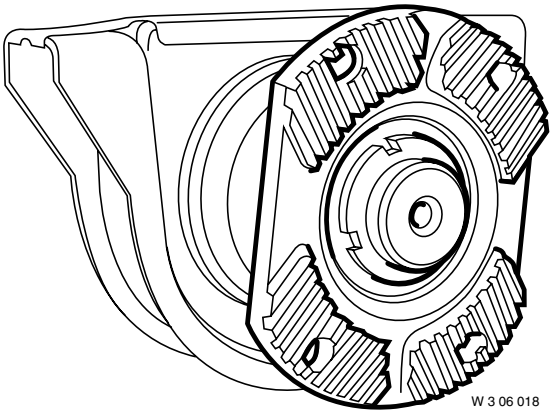
6. Attach the centre bearing to the chassis by means of bolts, but do not tighten the bolts.
7. Tighten the central nut of the centre bearing to the specified tightening torque. See “Technical data”.
   Then apply Loctite 243 to the attachment bolts of the centre bearing to the chassis and carry out final tightening to the specified tightening torque. See “Technical data”.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11

5. LUBRICATION

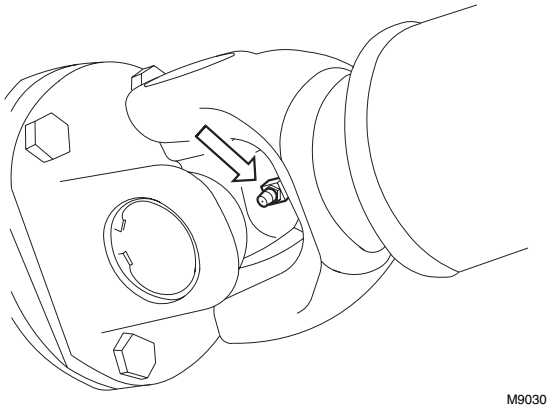
5.1 LUBRICATION, PROP SHAFT AND AUXILIARY SHAFT

1. **Note:**
   Standard vehicles have a maintenance-free prop shaft. Vehicles that are to be used in heavy conditions are fitted as standard with lubricating nipples in the prop shaft spiders. The following applies to these vehicles:

   Before lubricating, clean the lubricating nipple with a cloth.

2. **Note:**
   The maximum lubricating pressure should not exceed 15 bar.

   Grease the universal joints of the prop shaft until clean grease comes out of all four needle sleeve seals.



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CONTENTS

		Page	Date
1.	**SAFETY INSTRUCTIONS**	1-1	200337
2.	**GENERAL**	2-1	200337
2.1	Overview drawing, intarder	2-1	200337
2.2	Overview drawing, hydraulic control unit	2-2	200337
2.3	Location of main components	2-3	200337
3.	**INSPECTION AND ADJUSTMENT**	3-1	200337
3.1	Inspection and adjustment, output shaft bearing axial play	3-1	200337
3.2	Inspection and adjustment, stator axial play	3-2	200337
3.3	Inspection, gearbox/intarder oil level	3-3	200337
4.	**REMOVAL AND INSTALLATION**	4-1	200337
4.1	Removal and installation, intarder assembly	4-1	200337
4.2	Removal and installation, air supply solenoid valve	4-3	200337
4.3	Removal and installation, accumulator	4-4	200337
4.4	Removal and installation, heat exchanger	4-5	200337
4.5	Removal and installation, hydraulic control unit	4-7	200337
4.6	Removal and installation, oil pump	4-9	200337
4.7	Removal and installation, oil filter	4-10	200337
4.8	Removal and installation, proportional valve	4-12	200337
4.9	Removal and installation, intarder drive	4-13	200337
5.	**DISASSEMBLY AND ASSEMBLY**	5-1	200337
5.1	Disassembly and assembly, accumulator	5-1	200337
6.	**DRAINING AND FILLING**	6-1	200337
6.1	Draining and filling, gearbox/intarder	6-1	200337

12

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1. SAFETY INSTRUCTIONS

Be careful when changing the oil. Hot oil may cause serious injuries.

Avoid unnecessary contact with drained oil. Frequent contact damages the skin.

Various kinds of oil and other lubricants used on the vehicle may constitute a health hazard. This also applies to coolants. It is therefore important to avoid inhaling and direct contact.

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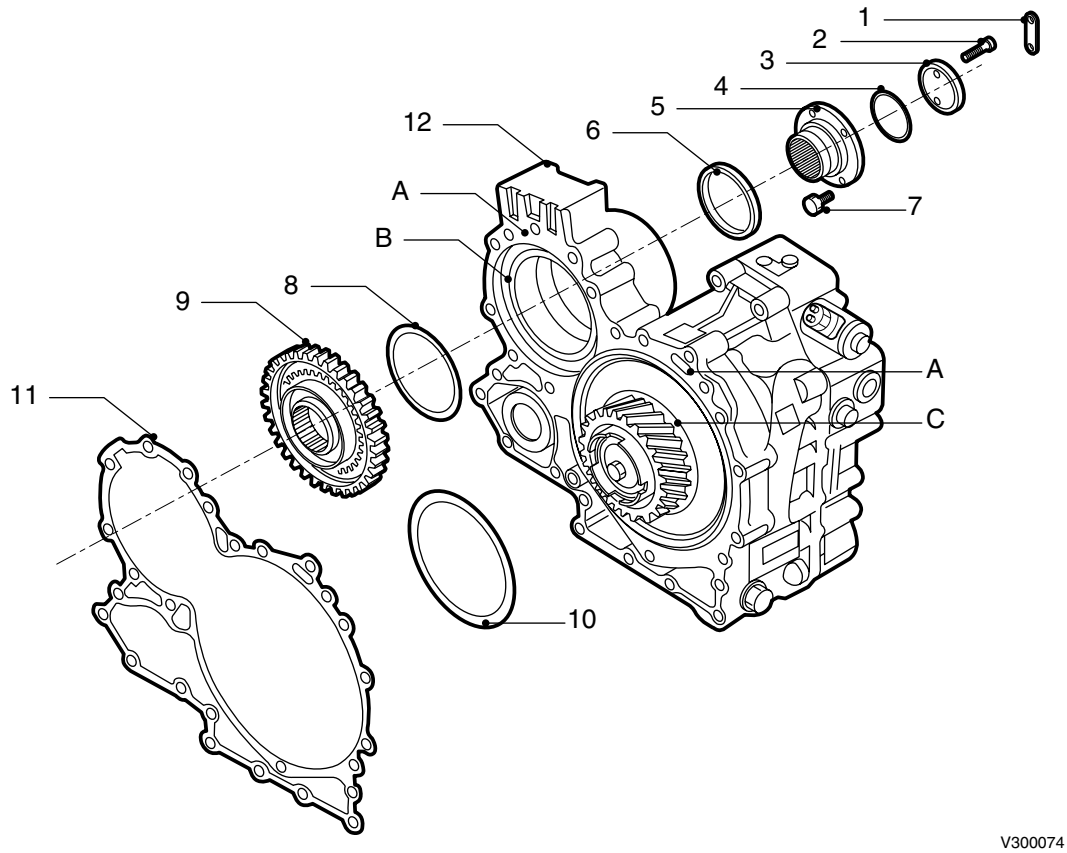
2. GENERAL

2.1 OVERVIEW DRAWING, INTARDER

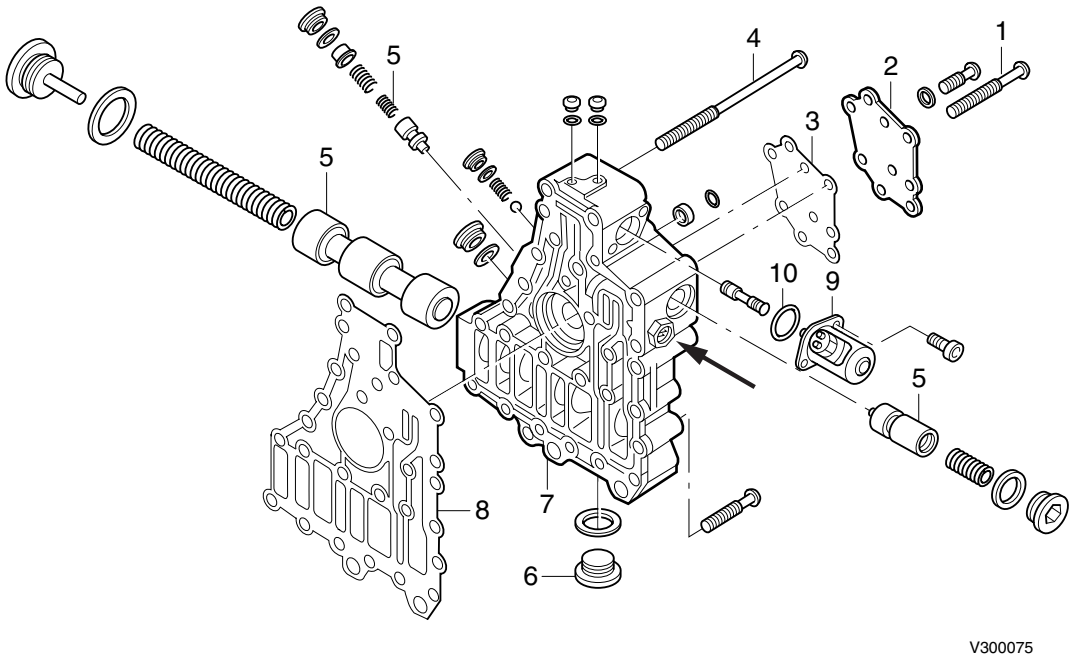


1. Locking plate
2. Bolt
3. Plate
4. O-ring
5. Prop shaft flange
6. Oil seal
7. Flange bolt
8. Output shaft shim
9. Drive sprocket
10. Stator shim
11. Gasket
12. Intarder housing

A Intarder housing sealing surface
B Ball bearing sealing surface
C Stator contact surface

12

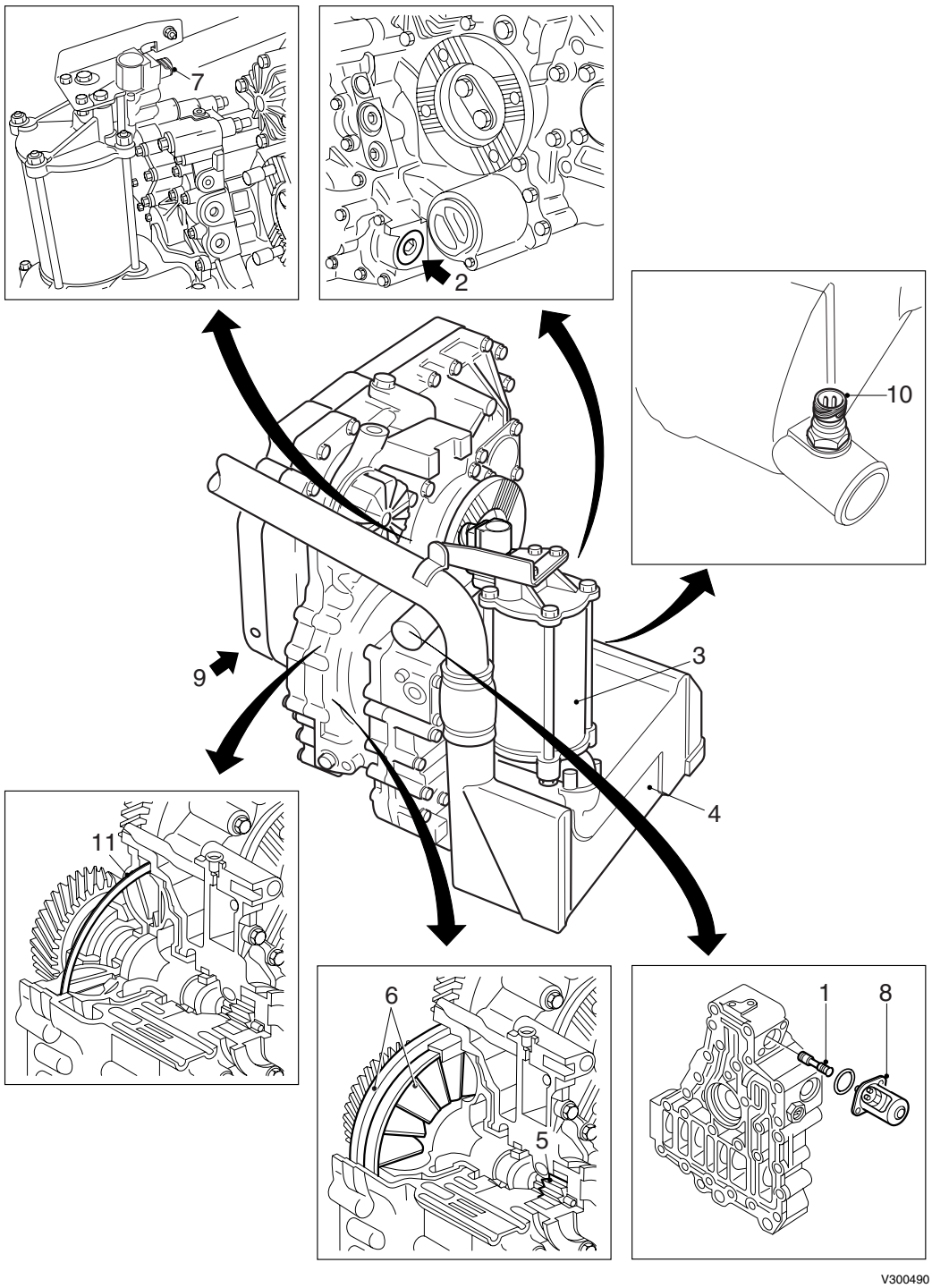
2.2 OVERVIEW DRAWING, HYDRAULIC CONTROL UNIT



1. Attachment bolt
2. Attachment plate
3. Gasket
4. Attachment bolt
5. Plungers and springs
6. Drain plug
7. Control unit housing
8. Gasket
9. Proportional valve
10. O-ring

12

2.3 LOCATION OF MAIN COMPONENTS



1. Intarder proportional valve control plunger
2. Selector valve spring sealing plug
3. Accumulator
4. Heat exchanger
5. Oil pump gear wheels
6. Stator and rotor
7. Air supply solenoid valve
8. Proportional valve
9. Attachment to gearbox
10. Coolant temperature sensor
11. Freewheeling torque reduction ring segment

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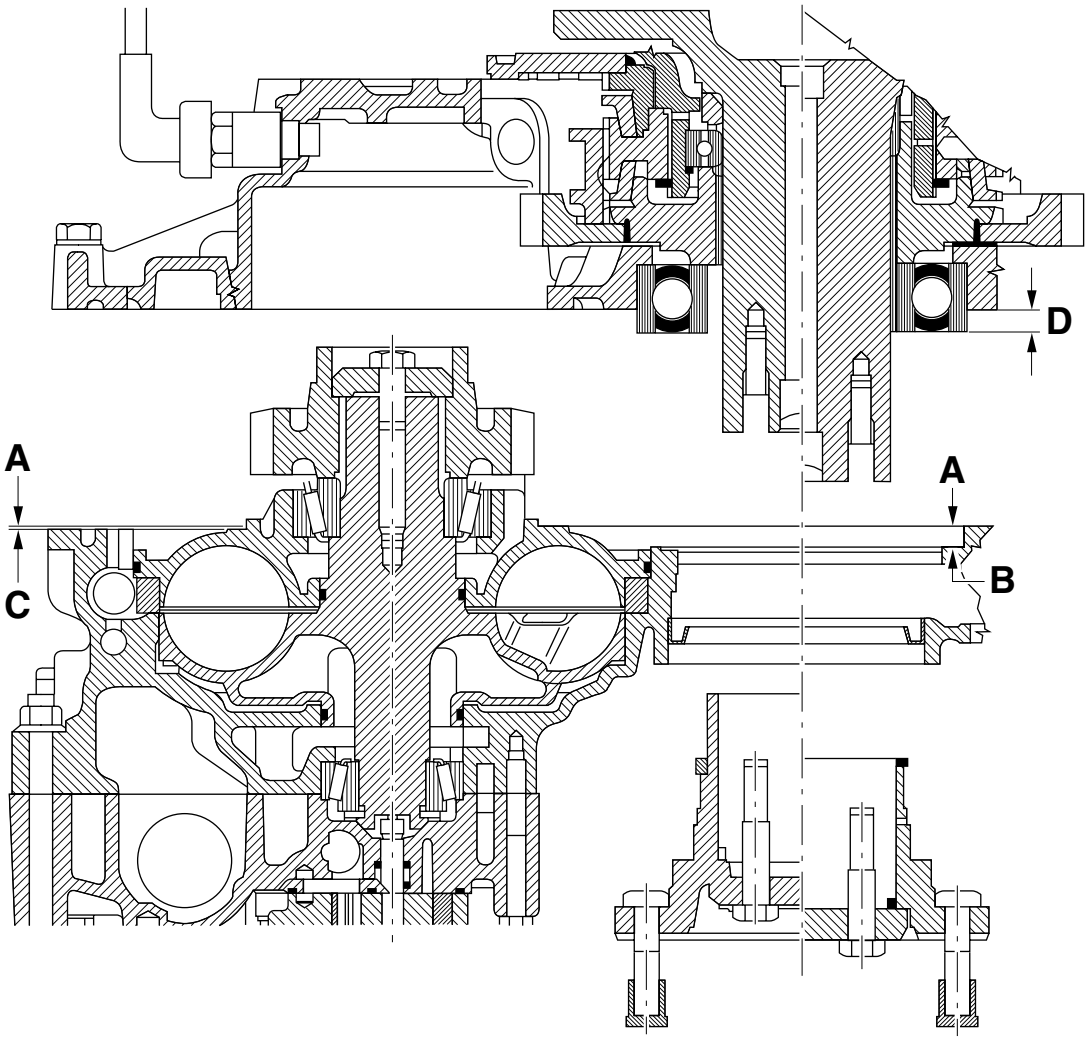
3. INSPECTION AND ADJUSTMENT

3.1 INSPECTION AND ADJUSTMENT, OUTPUT SHAFT BEARING AXIAL PLAY



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1. Measure and note down distance “A - B” from sealing surface A with gasket to contact surface B.
2. Measure and note down distance “D” from the ball bearing outer race to the gasket on the gearbox.

Example:	
Distance A - B =	10.5 mm
Distance D =	10.0 mm
Difference =	0.5 mm
Maximum play	0.1 mm
Required thickness of shim	0.4 mm

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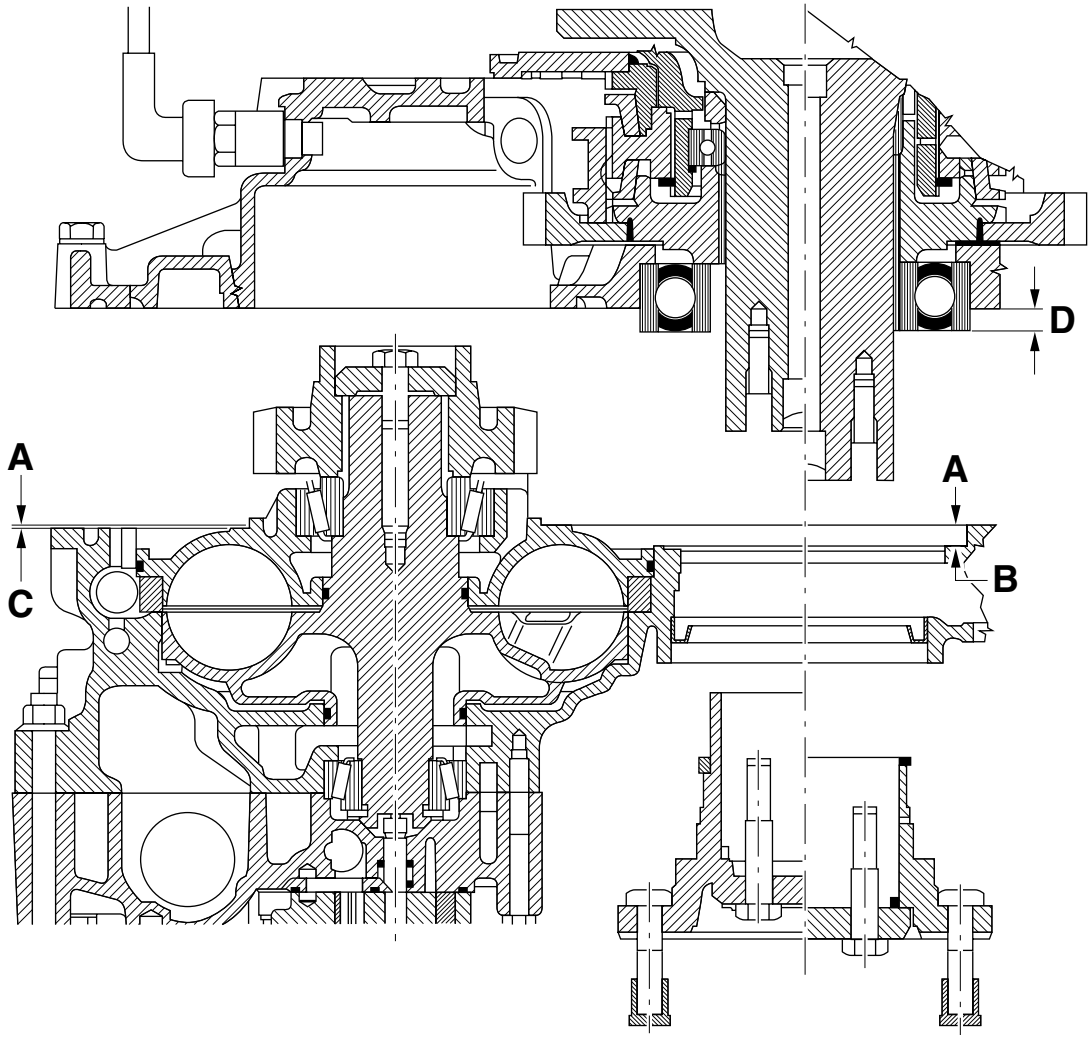
3.2 INSPECTION AND ADJUSTMENT, STATOR AXIAL PLAY



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1. Measure and note down distance “A - C” from sealing surface A with gasket to contact surface C.

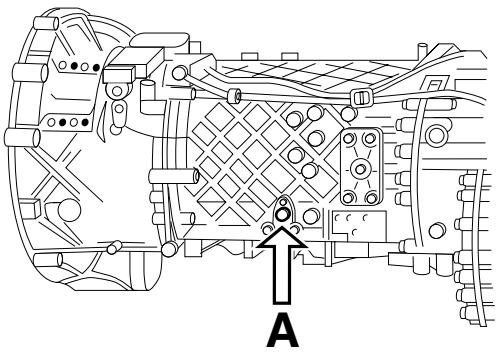
Example:	
Distance A - C =	1.10 mm
Distance A - C should be	0 ±0.05 mm
Required thickness of shim	1,1 ±0.05 mm

12

3.3 INSPECTION, GEARBOX/INTARDER OIL LEVEL

Inspection, gearbox/intarder oil level

1. Slow the vehicle down without using the intarder and place the vehicle on a level surface.
2. Wait for some minutes for the gearbox oil to flow back.
3. The oil level must reach the rim of the oil level check opening (A).



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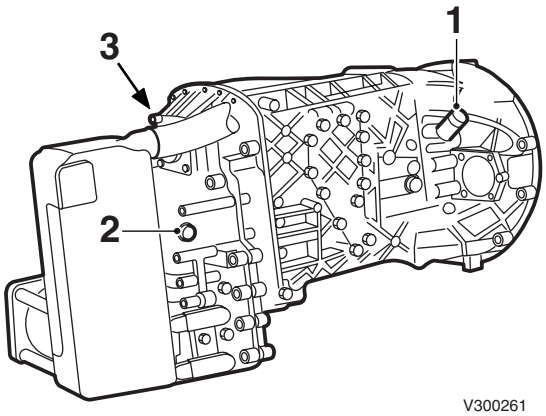
4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION, INTARDER ASSEMBLY

To prevent skin injury, avoid unnecessary contact with the drained oil.
In the course of the following operations, oil will spill from the gearbox and intarder. Collect this oil.

Removing the intarder assembly

1. Remove the prop shaft bolts and hang the prop shaft to the side in the chassis.
2. Drain the gearbox via drain plugs (1 and 2).
3. Drain as much coolant and gearbox oil as necessary and collect in clean containers.
4. Disconnect the water hoses from both sides of the heat exchanger.
5. Remove the air pipe from the intarder solenoid valve.
6. Remove all electrical wiring from the intarder.
7. Remove the locking plate from the output prop shaft flange, remove the disk with the O-ring, and pull the drive flange from the shaft using a tripod puller.



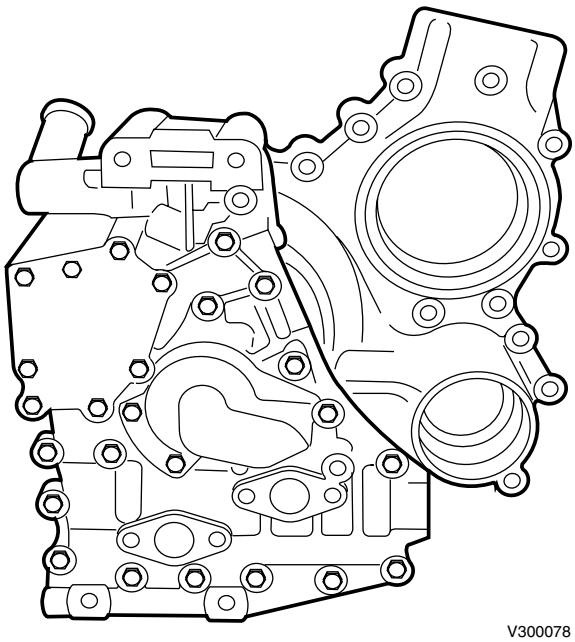
In the course of the following operations, the intarder is disconnected from the gearbox. Take measures to prevent the intarder from dropping.

8. Remove the attachment bolts from the intarder and remove the intarder.
9. Remove the gasket and shims from the adjustment stator/output shaft.

12

Installing the intarder assembly

1. Stick the correct shims onto the contact surfaces using a little grease. See “Inspection and adjustment”.
2. Fix the gasket in the gearbox with as many long studs as possible. The studs also serve as guiding pins to facilitate mounting of the intarder
3. Carefully position the intarder on the gearbox and tighten the attachment bolts to the specified torque. See “Technical data”.
4. Insert the prop shaft attachment bolts from the correct side into the output prop shaft flange (bolt end faces prop shaft).
5. Install the output prop shaft flange without heating it.
6. Install the O-ring and the disk.
7. Install the attachment bolts and tighten them to the specified torque. See “Technical data”.
   Fit the lock plate using the special tool (DAF No. 0694903).
8. Connect the water hoses to the heat exchanger.
9. Connect the air pipe to the solenoid valve.
10. Make all electrical connections to the intarder.
11. Install the prop shaft and tighten the prop shaft attachment bolts to the specified torque. See “Technical data”.
12. Fill the coolant system and fill the intarder and gearbox with oil.
13. Check the operation of the intarder and check for leaks.
14. Check the oil level in the gearbox. See “Inspection and adjustment”.



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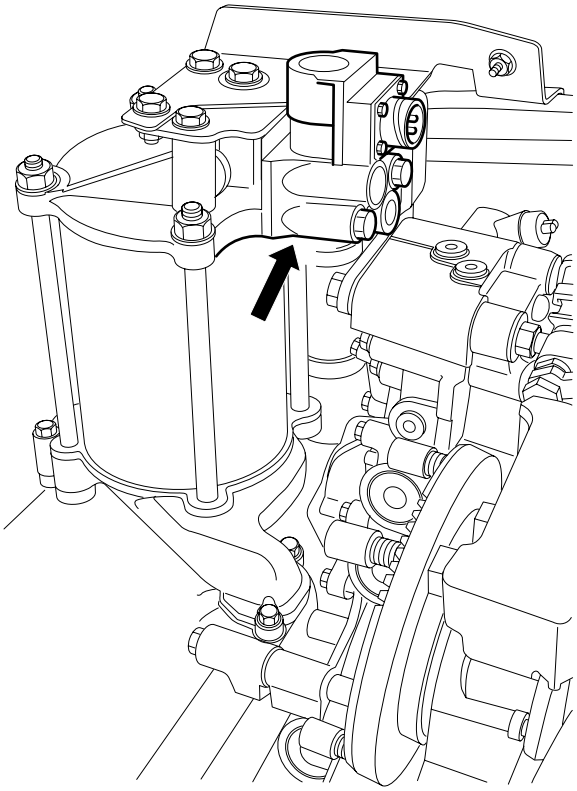
4.2 REMOVAL AND INSTALLATION, AIR SUPPLY SOLENOID VALVE

Removing the air supply solenoid valve

1. Remove the air pipe from the solenoid valve.
2. Remove the electric wiring from the solenoid valve.
3. Remove the attachment bolts from the solenoid valve and remove the solenoid valve.
4. Remove the O-ring.

Installation, air supply solenoid valve

1. Fit a new O-ring in the slot on the solenoid valve.
2. Install the solenoid valve.
3. Connect the electrical wiring to the solenoid valve.
4. Connect the air pipe to the solenoid valve.



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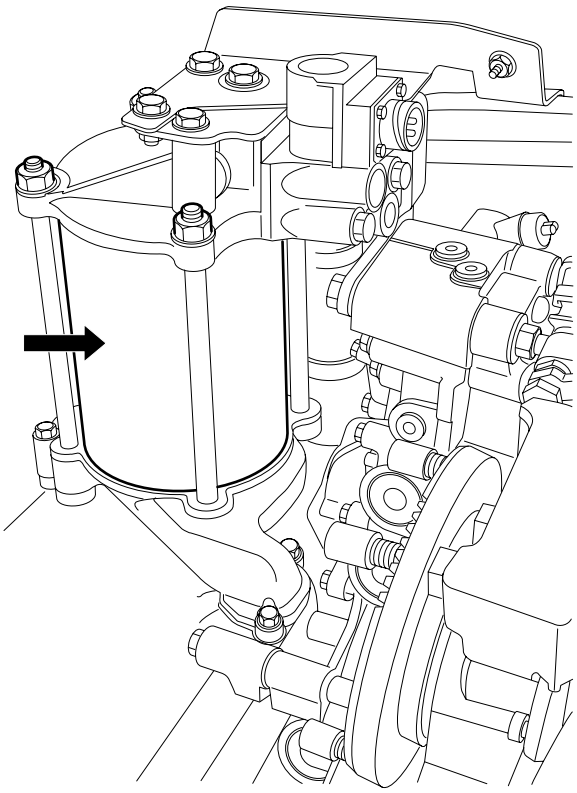
4.3 REMOVAL AND INSTALLATION, ACCUMULATOR

To prevent skin injury, avoid unnecessary contact with the drained oil.
In the course of the following operations, oil and water will escape from the heat exchanger. Collect the oil and water.
To prevent skin injury, avoid unnecessary contact with the drained oil.

Removing the accumulator

1. Drain as much coolant and oil as necessary.
2. Disconnect the water hose from the left-hand side of the heat exchanger.
3. Remove the air pipe from the solenoid valve.
4. Remove the electrical wiring from the solenoid valve.
5. Remove the attachment bolt from the water pipe bracket and the attachment bolts on top of the accumulator bracket.
6. Take out the bolts attaching the accumulator to the heat exchanger and remove the accumulator.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Installing the accumulator

1. Fit new O-rings on the accumulator bracket and install the accumulator on the heat exchanger.
2. Install the accumulator bracket attachment bolts at the top.
3. Fit the water pipe bracket attachment bolt.
4. Install the solenoid valve.
5. Connect the air pipe to the solenoid valve.
6. Connect the electrical wiring to the solenoid valve.
7. Install the water hose at the left-hand side.
8. Fill the cooling system.
9. Fill the gearbox with oil. Check the oil level in the gearbox. See “Inspection and adjustment”.

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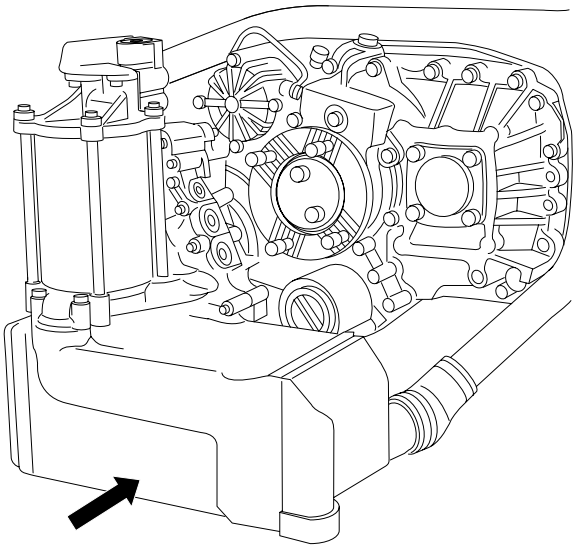
4.4 REMOVAL AND INSTALLATION, HEAT EXCHANGER

In the course of the following operations, oil and water will escape from the heat exchanger. Collect the oil and water. Take measures to prevent the heat exchanger from falling down.

Removing the heat exchanger

1. Drain as much coolant and oil as necessary.
2. Remove the water hoses from the heat exchanger.
3. Remove the air pipe from the solenoid valve.
4. Remove all electrical wiring from the intarder.
5. Remove the attachment nuts from the studs attaching the heat exchanger to the hydraulic control unit.
6. Remove an attachment bolt from the heat exchanger oil connection flange attached to the rear cover of the gearbox.
7. Remove the heat exchanger together with the accumulator.
8. Remove the two O-rings for the oil ducts of the heat exchanger from the control unit.
9. If necessary, remove the accumulator and the solenoid valve.
10. If the heat exchanger displays any leaks, it must be replaced, as it cannot be repaired.



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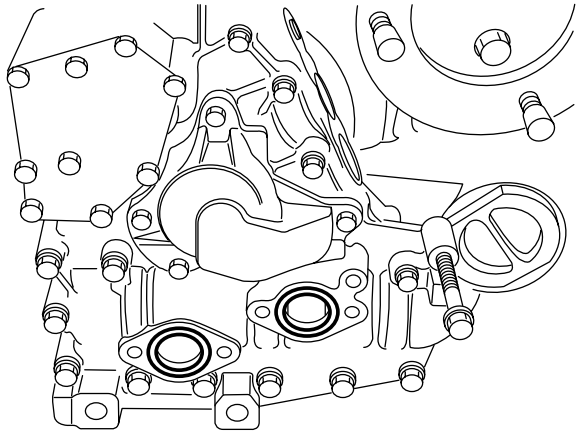

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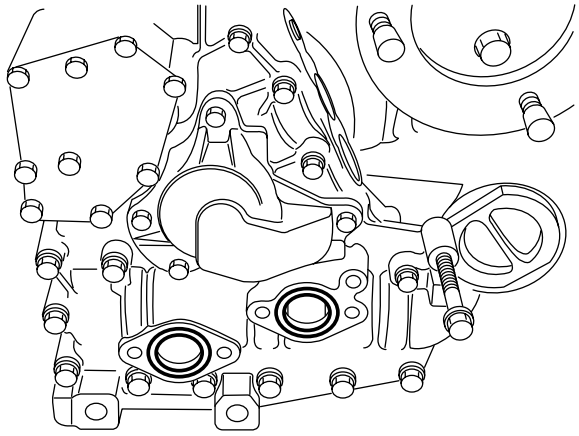
Installing the heat exchanger

1. Insert new O-rings into the circular slots of the control unit.
2. Install the studs in the heat exchanger and tighten them to the specified torque. See “Technical data”.
3. Apply Loctite to the contact surfaces, studs, and attachment nuts/bolt. See “Technical data”.
4. Install the heat exchanger on the control unit and tighten the attachment nuts to the specified torque. See “Technical data”.
5. Install the heat exchanger oil connection flange attachment bolt which is attached to the rear cover of the gearbox, and tighten to the specified torque. See “Technical data”.
6. Connect the water hoses to the heat exchanger.
7. Connect the air pipe to the solenoid valve.
8. Connect the electrical wiring to the intarder.
9. Fill the cooling system.
10. Fill the gearbox with oil.
11. Check the oil level in the gearbox. See “Inspection and adjustment”.



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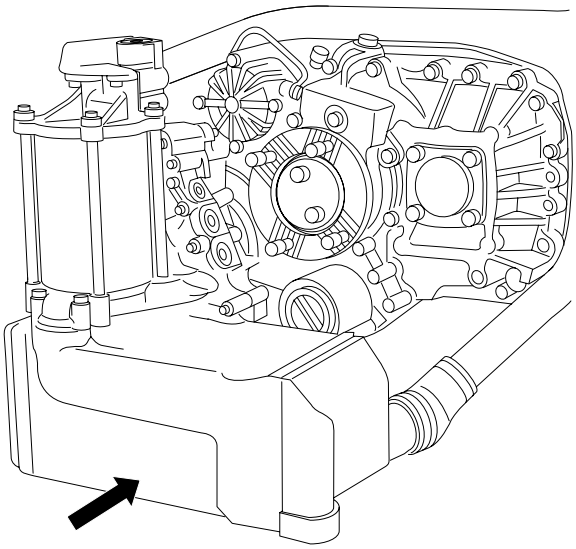

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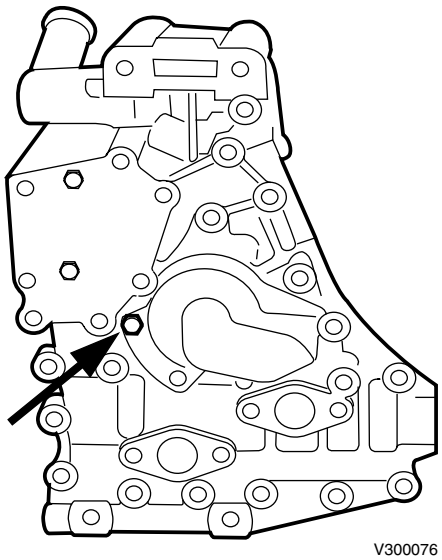
4.5 REMOVAL AND INSTALLATION, HYDRAULIC CONTROL UNIT

In the course of the following operations, oil and water will escape from the heat exchanger and control unit. Collect the oil and water. Take measures to prevent the heat exchanger from falling down.

Removing the hydraulic control unit

1. Remove the heat exchanger.
2. Remove the electrical wiring from the proportional valve.
3. Remove the bolts attaching the control unit to the gearbox. Leave one attachment bolt of the oil pump in place: see illustration.



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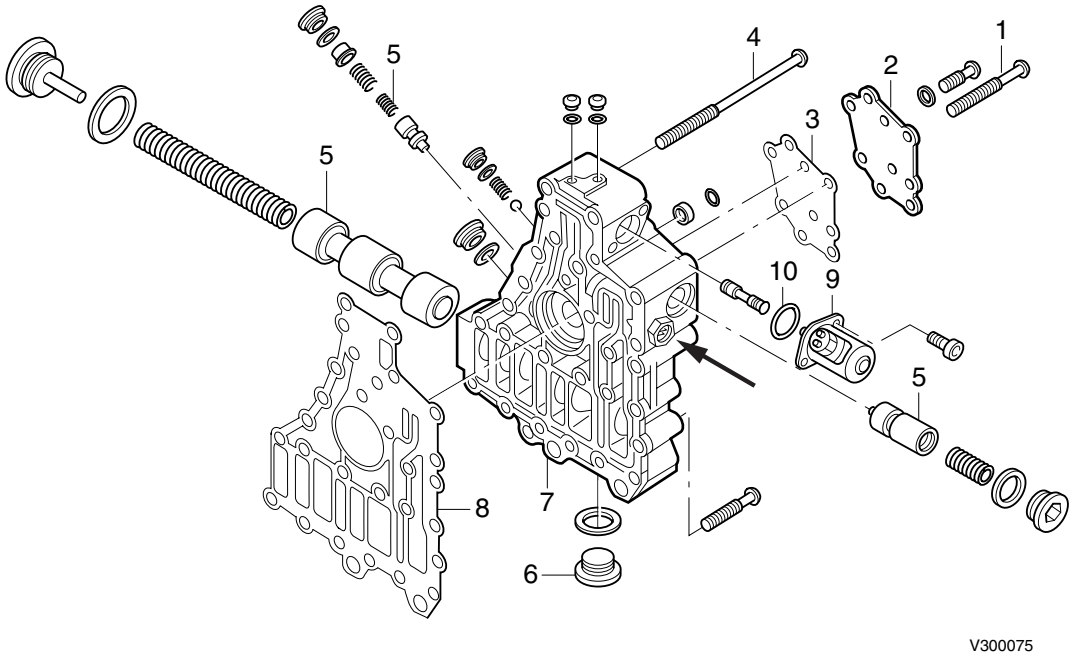


4. Remove the control unit (7) and the gasket (8).

5. If necessary, remove and inspect the plungers and springs (5). Avoid damaging the plungers and plunger guides.

   Note:
   The sealed plunger (see arrow in illustration) must not be removed; after removal, the intarder must be set again on the test bench.

Installing the hydraulic control unit

1. Fix the gasket (8) in the gearbox with as many long studs as possible. The studs also serve as guide pins to facilitate mounting of the control unit.

2. Line up the end of the oil pump with the output side of the stator.

3. Fit the control unit over the studs and be sure to position the control unit carefully against the housing to make sure that the oil pump is in its place in the stator. Tighten the attachment bolts to the specified torque. See “Technical data”.

4. Install the heat exchanger.

12

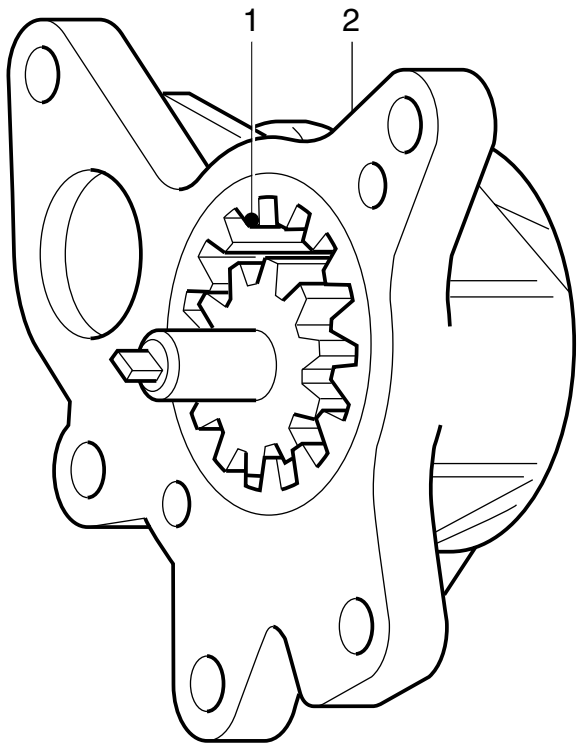
4.6 REMOVAL AND INSTALLATION, OIL PUMP

Removing the oil pump

1. Remove the heat exchanger.
2. Remove the bolts attaching the oil pump (2) to the control unit.
3. Remove the entire oil pump from the control unit and remove the O-ring.
4. Check the axial play of the outer rotor. See “Technical data”.
   Check the pump housing for the presence of slots. If necessary, replace the entire oil pump.

Installing the oil pump

1. Fit a new O-ring in the slot on the control unit.
2. Install the outer rotor so that the mark (1) is visible.
3. Fit the entire oil pump (2) to the control unit. Ensure that the flat end of the inner rotor is in line with the stator.
4. Install the oil pump attachment bolts and tighten them to the specified torque. See “Technical data”.
5. Install the heat exchanger.



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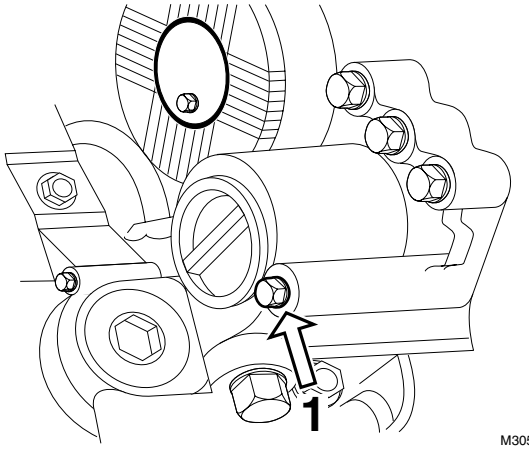
4.7 REMOVAL AND INSTALLATION, OIL FILTER

To prevent skin injury, avoid unnecessary contact with the drained oil.

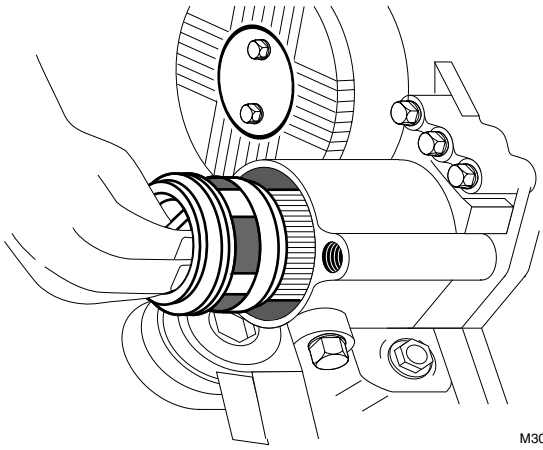
Removing the gearbox oil filter

1. Remove the attachment bolt (1) of the oil filter.



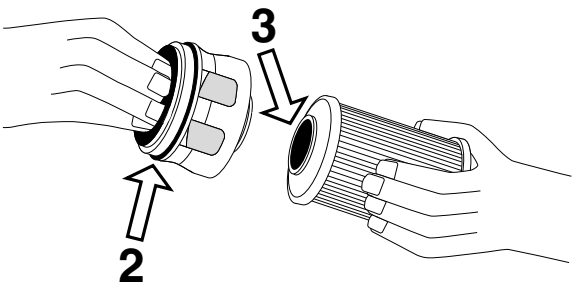
M3052

2. Pull the filter cover with the filter from the filter housing.


M3053

3. Remove the filter (3) from the filter cover (2). Do not clean the filter. The filter must always be replaced.

   Note:
   If the magnetic disk is still attached to the back of the filter, separate it from the filter element and fit it to the new filter element.



M3054

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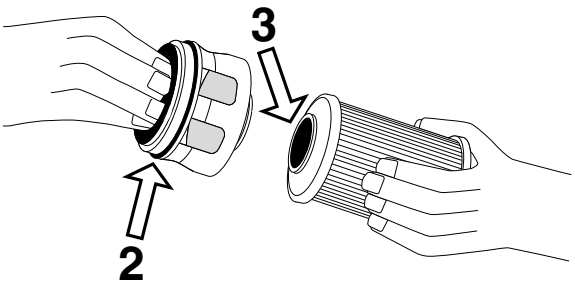
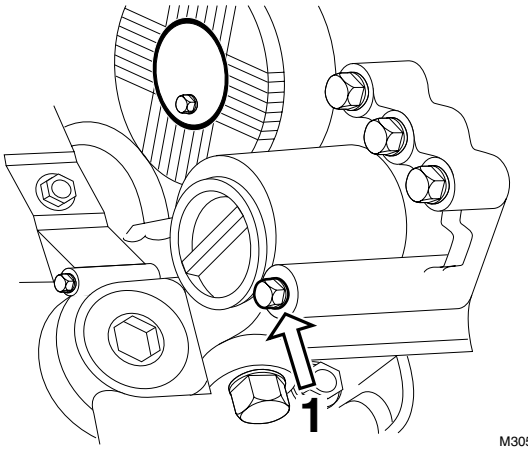
Installing the gearbox oil filter

1. Check the O-ring of the filter cover (2) for any damage. Replace the O-ring if necessary.
   Grease the O-ring.
2. Grease the O-ring of the new filter (3) and place the filter on the filter cover.
   Then insert the filter and the filter cover into the filter housing.
3. Use a plastic mallet to tap the filter cover into the filter housing.
4. Tighten the attachment bolt (1) to the specified torque. See “Technical data”.



M3054



M3052

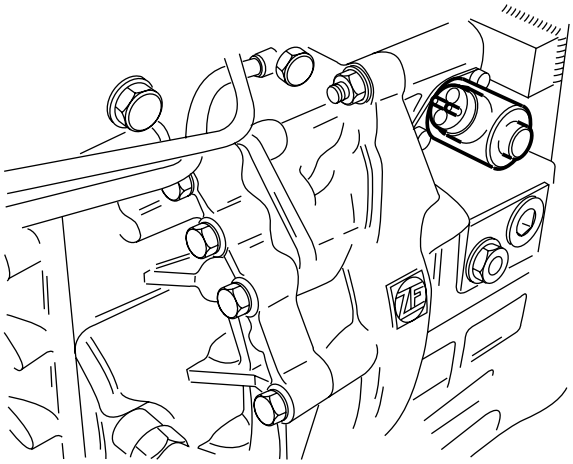
4.8 REMOVAL AND INSTALLATION, PROPORTIONAL VALVE

Removing the proportional valve

1. Remove the electrical wiring from the valve.
2. Remove the attachment bolts and remove the proportional valve.
3. Remove the O-ring.

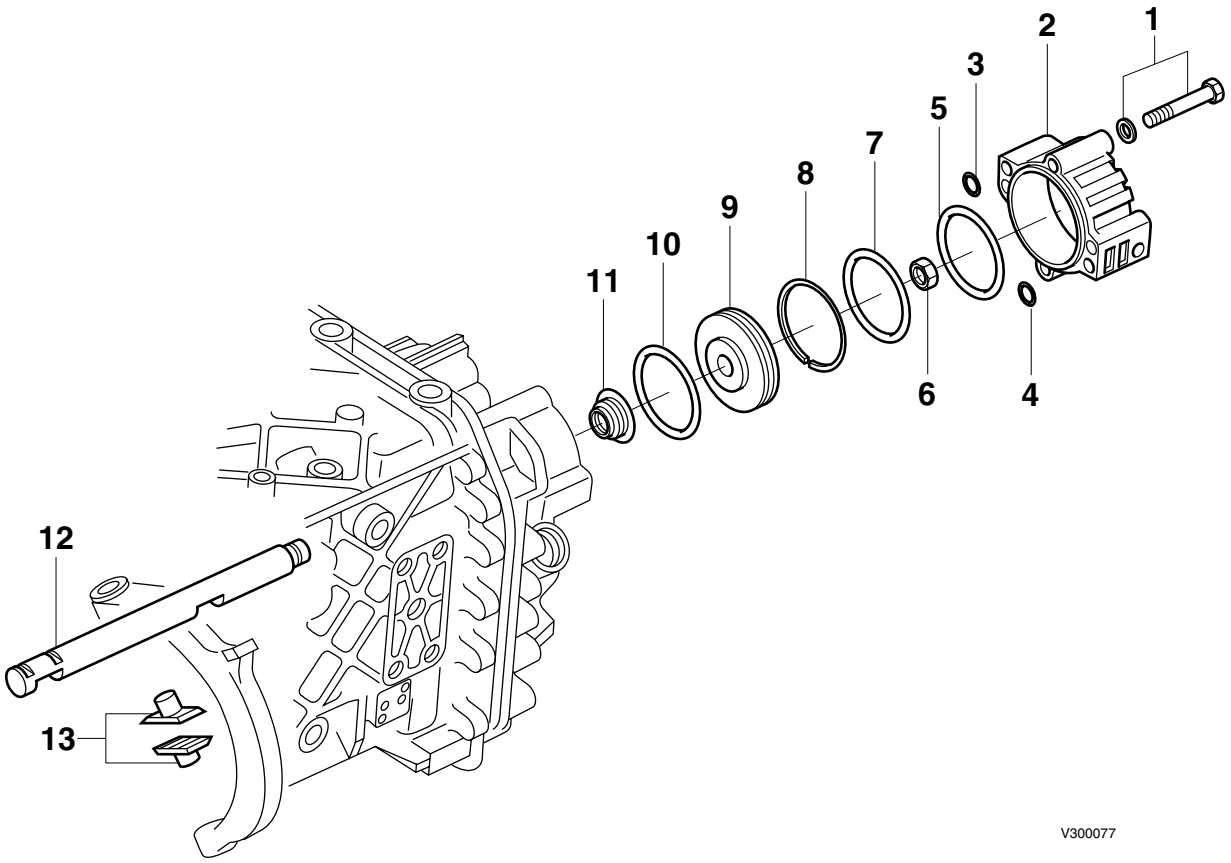
Installing the proportional valve

1. Fit a new O-ring on the proportional valve and lightly grease the O-ring.
2. Install the proportional valve and tighten the attachment bolts to the specified torque. See “Technical data”.
3. Connect the electrical wiring to the valve.



V300011

4.9 REMOVAL AND INSTALLATION, INTARDER DRIVE

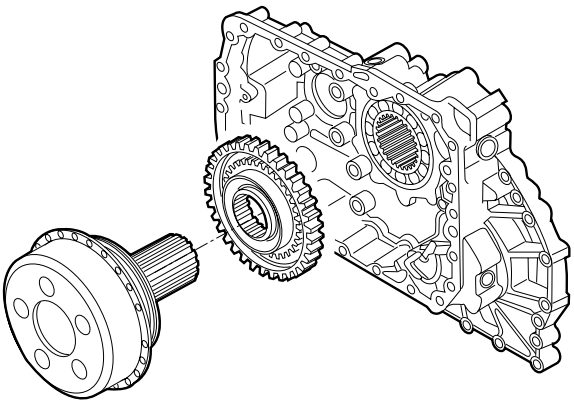


Removing the intarder drive

1. Remove the intarder.
2. Remove the air connections from the high/low shift control to the cylinder (2).
3. Remove the attachment bolts (1) of the cylinder (2) and remove the cylinder.
4. Remove the lock nut (6) of the piston (9) and remove the piston and its O-rings.
5. Remove the two locking bolts of the high/low shifting fork.

12

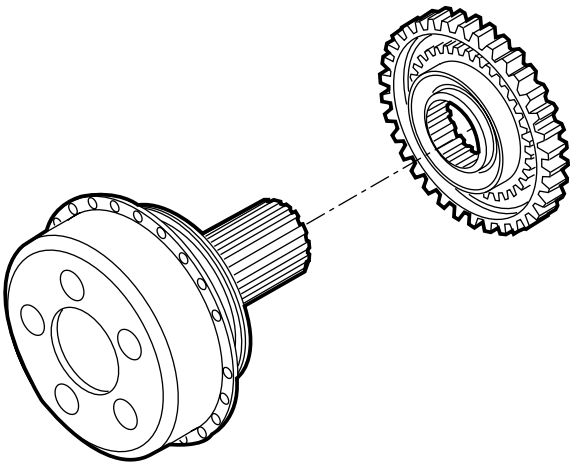
6. Remove the attachment bolts from the rear cover and remove the rear cover. Make sure the intarder remains in place.
7. Remove the gearbox gasket.
8. If necessary, use a tripod puller to remove the drive sprocket from the intarder.



V300081

Installing the intarder drive

1. Heat the drive sprocket and install the drive sprocket onto the intarder. See “Technical data”.
2. Install the gasket on the gearbox housing.
3. Install the rear cover over the guide pins. Pay attention to the shifting fork when doing so. Insert the locking bolts of the shifting fork into the rear cover and hand-tighten them.
4. Install the rear cover attachment bolts and tighten them to the specified torque. See “Technical data”.
5. Tighten the locking bolts of the shifting fork to the specified torque. See “Technical data”.



V300079

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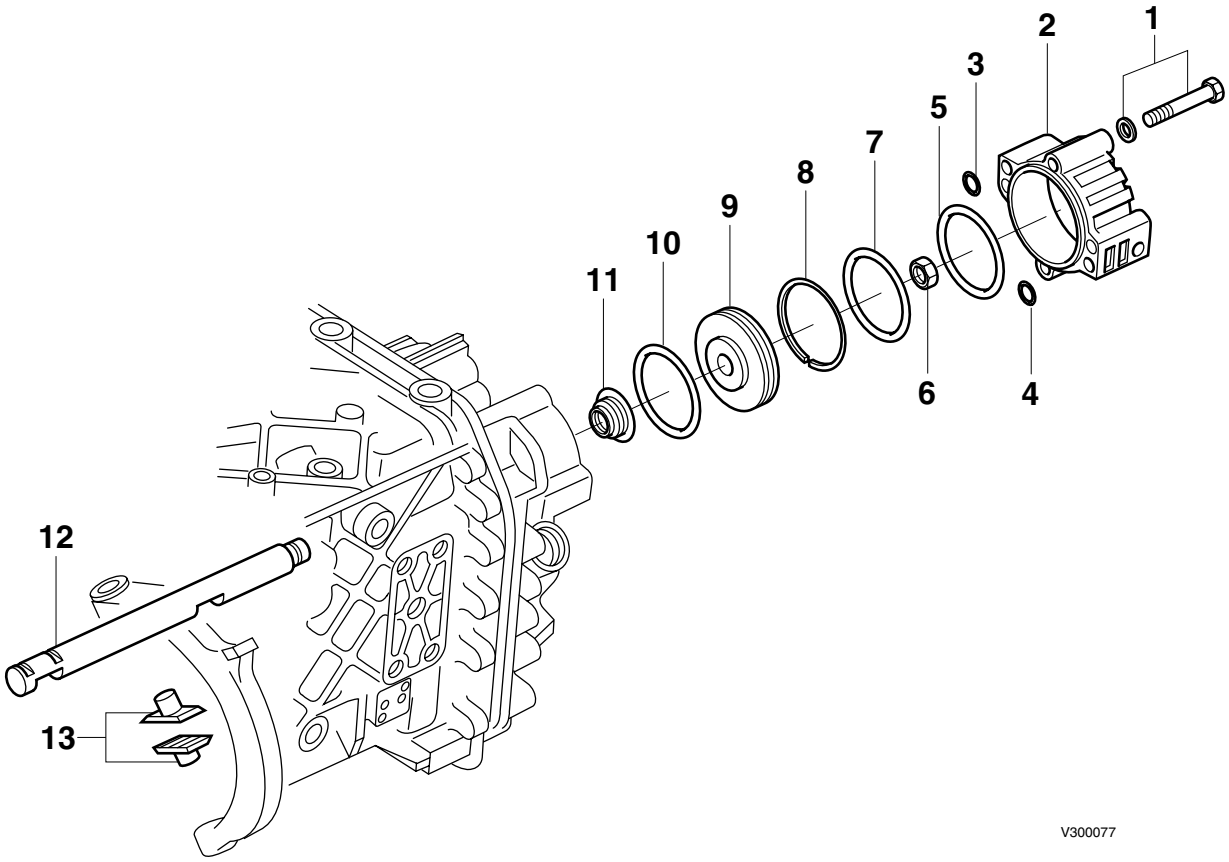

6. Install the piston (9) on the selector shaft and tighten the lock nut (6) to the specified torque. See “Technical data”.
7. Install the cylinder (2) and tighten the attachment bolts to the specified torque. See “Technical data”.
8. Connect the air supply.
9. Install the intarder.

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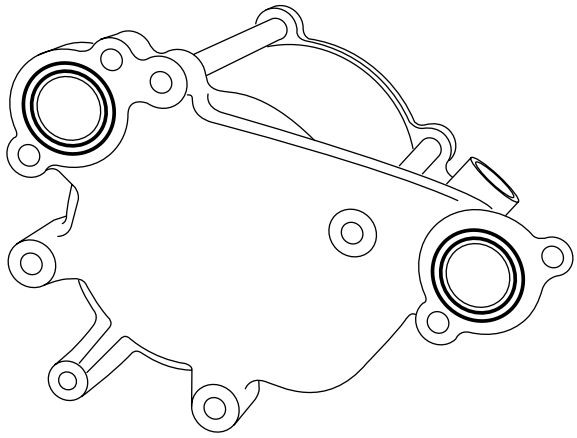
5. DISASSEMBLY AND ASSEMBLY

5.1 DISASSEMBLY AND ASSEMBLY, ACCUMULATOR

Disassembling the accumulator

1. Take out the bolts and/or nuts attaching the cylinder to the accumulator bracket, and remove the bracket.
2. Remove the O-rings on the bottom of the sealing surfaces of the accumulator/heat exchanger.
3. Remove the O-rings from the accumulator cylinder.
4. Remove the piston and sleeves from the cylinder.
5. Remove the sleeves from the piston and the scraper rings from the middle of the piston.
6. Check the cylinder for damage.



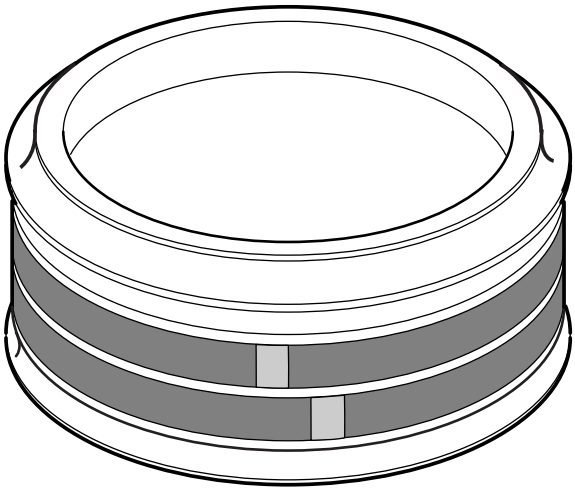
V300197

Assembling the accumulator

1. Install the central scraper rings on the piston.

   Note:
   There are two different types of sleeve: one with and one without a steel inner spring.

2. Install the sleeve with the steel inner spring at the oil side of the piston.
3. Install the sleeve without the steel inner spring at the air side of the piston.
4. Thoroughly cover the piston and cylinder with grease and install the piston in the cylinder.
5. Fit the two O-rings at both sides of the cylinder.
   Apply grease to the O-rings to make sure they remain in position.
6. Install the cylinder on the accumulator bracket.
7. Install new O-rings at the bottom of the accumulator/heat exchanger and install the accumulator.



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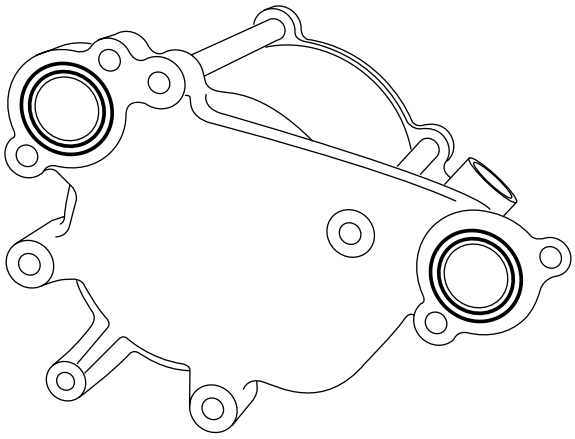

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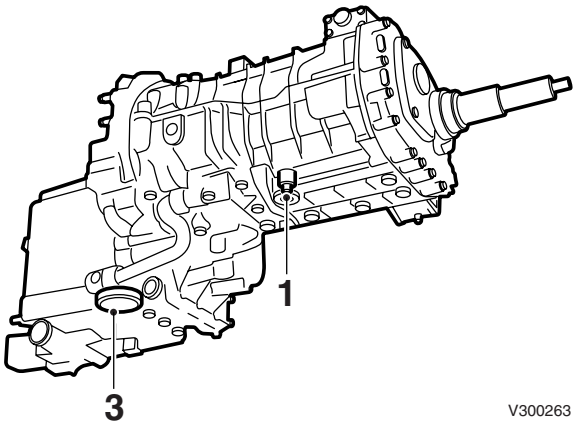
6. DRAINING AND FILLING

6.1 DRAINING AND FILLING, GEARBOX/INTARDER

Draining the gearbox

ZF 8/9/16S-109

1. Before draining take a short test drive. Do **not** activate the intarder during the test drive.
2. Place the vehicle on a level surface.
3. Drain the gearbox at operating temperature via drain plugs 1 and 2.
4. Replace the oil filter (3). See “Removal and installation”.

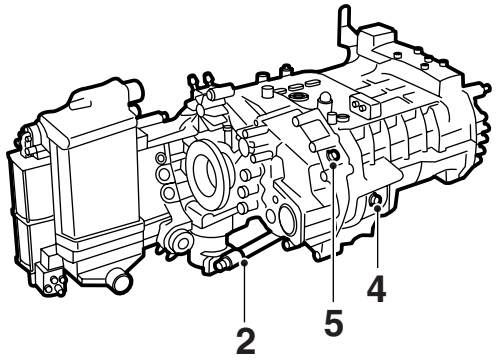


V300263

Filling, gearbox (oil change)

ZF 8/9/16S-109

1. Clean the drain plugs and tighten them to the specified torque. See “Technical data”.
2. Fill the oil through the level check/filler opening (4) until the oil reaches the rim of the filler opening (4).
3. After filling take a short test drive. Do **not** activate the intarder during the test drive.
4. After the test drive, check the oil level. The oil level must reach the rim of the level check/filler opening (4).
5. Tighten the level check/filler plug to the specified torque. See “Technical data”.



V300262

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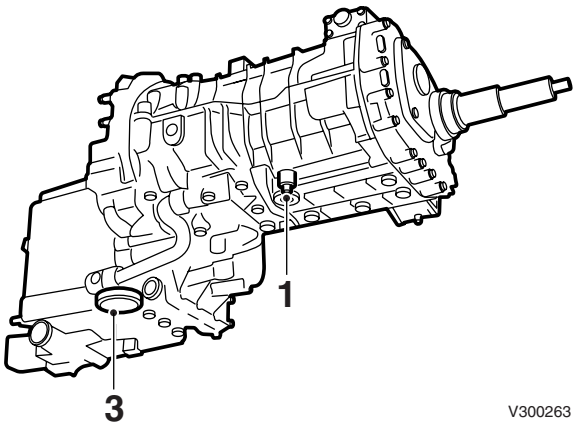
Filling, gearbox (after repair or with a new gearbox)

ZF 8/9/16S-109

1. Place the vehicle on a level surface.
2. Fill the oil through the filler openings (5) until the oil reaches the rim of the level check/filler opening (4).
3. After filling take a short test drive. The intarder must be **briefly** fully activated at the beginning of the test drive.
4. After the test drive, check the oil level. The oil level must reach the rim of the level check/filler opening (4).
5. Tighten the filler plug (5) and the level check plug (4) to the specified torque. See “Technical data”.



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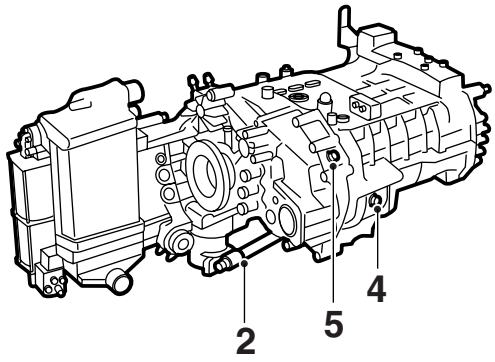

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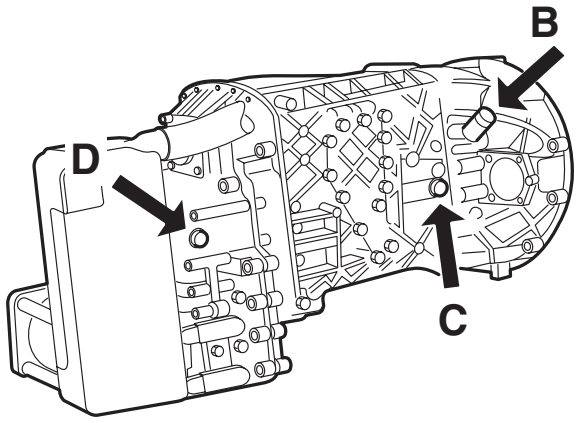
Draining the gearbox

ZF 16S-151/181/221

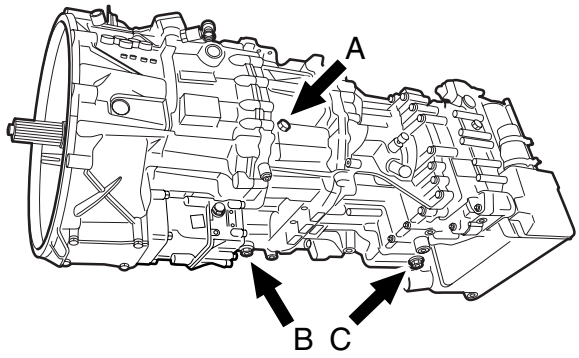
1. Before draining take a short test drive. Do **not** activate the intarder during the test drive.
2. Place the vehicle on a level surface.
3. Drain the gearbox at operating temperature using plugs B, C and D.
4. Replace the oil filter. See “Removal and installation”.



V300186

ZF AS Tronic

1. Before draining take a short test drive. Do **not** activate the intarder during the test drive.
2. Place the vehicle on a level surface.
3. Drain the gearbox at operating temperature using plugs B and C.
4. Replace the oil filter. See “Removal and installation”.



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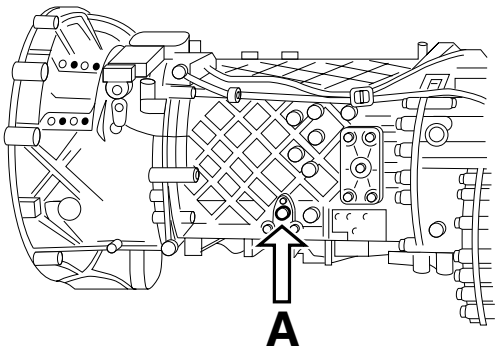
12

Filling, gearbox (oil change)

ZF 16S-151/181/221

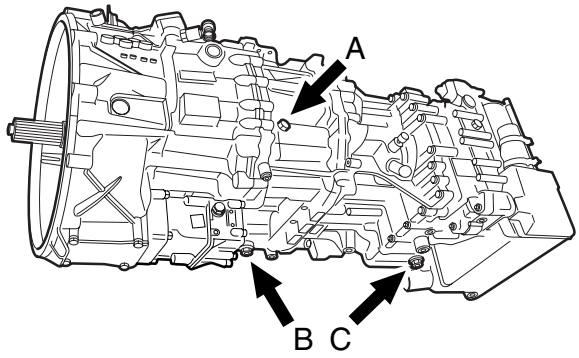
1. Clean the drain plugs and tighten them to the specified torque. See “Technical data”.
2. Top up oil through level check/filler opening (A) until the oil reaches the rim of the filler opening (A).
3. After filling take a short test drive. Do **not** activate the intarder during the test drive.
4. After the test drive, check the oil level. The oil level must reach the rim of the level check/filler opening (A).
5. Tighten the level check/filler plug to the specified torque. See “Technical data”.



M3051

ZF AS Tronic

1. Clean the drain plugs and tighten them to the specified torque. See “Technical data”.
2. Top up oil through level check/filler opening (A) until the oil reaches the rim of the filler opening (A).
3. After filling take a short test drive. Do **not** activate the intarder during the test drive.
4. After the test drive, check the oil level. The oil level must reach the rim of the level check/filler opening (A).
5. Tighten the level check/filler plug to the specified torque. See “Technical data”.



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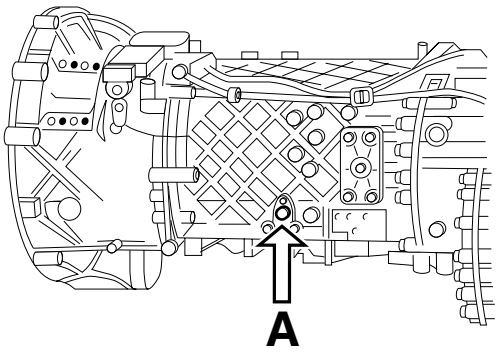
Filling, gearbox (after repair or with a new gearbox)

ZF 16S-151/181/221

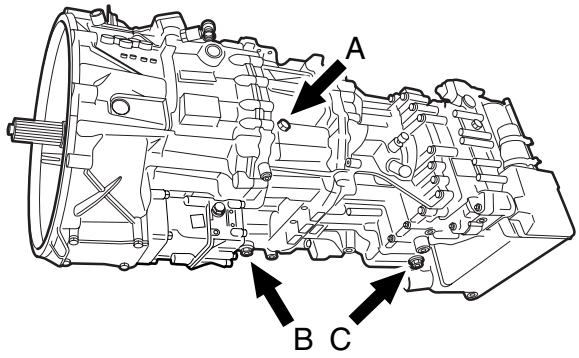
1. Place the vehicle on a level surface.
2. Top up oil to the rim through the level check/filler opening (A).
3. After filling take a short test drive. The intarder must be **briefly** fully activated at the beginning of the test drive.
4. After the test drive, check the oil level. The oil level must reach the rim of the level check/filler opening (A).
5. Tighten the level check/filler plug (A) to the specified torque. See “Technical data”.



M3051

ZF AS Tronic

1. Place the vehicle on a level surface.
2. Top up oil to the rim through the level check/filler opening (A).
3. After filling take a short test drive. The intarder must be **briefly** fully activated at the beginning of the test drive.
4. After the test drive, check the oil level. The oil level must reach the rim of the level check/filler opening (A).
5. Tighten the level check/filler plug (A) to the specified torque. See “Technical data”.



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12

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CONTENTS

		Page	Date
1.	**SAFETY INSTRUCTIONS**	1-1	200337
2.	**GENERAL**	2-1	200337
2.1	DAF engine PTO drive side cross section	2-1	200337
2.2	DAF engine PTO engine side cross section	2-2	200337
2.3	Overview drawings, DAF engine PTO without drive flange and control	2-3	200337
2.4	Overview drawings, DAF engine PTO with drive flange and without control	2-4	200337
2.5	Overview drawings, DAF engine PTO with drive flange and control	2-5	200337
2.6	Overview drawings, DAF engine PTO with third gear wheel for opposite drive flange direction of rotation	2-6	200337
2.7	Overview drawings, PTO versions	2-7	200337
2.8	Overview drawing, NL/1 and NH/1 PTO, B version	2-12	200337
2.9	Overview drawing, NL/1 and NH/1 PTO, C version	2-13	200337
2.10	Overview drawing, NL/4 and NH/4 PTO, B version	2-14	200337
2.11	Overview drawing, NL/4 and NH/4 PTO, C version	2-15	200337
2.12	Overview drawing, N221/10 PTO on gearbox without intarder	2-16	200337
2.13	Overview drawing, N221/10 PTO on gearbox with intarder	2-16	200337
2.14	Overview drawing, N AS/10 PTO	2-17	200337
2.15	Overview drawing, PTO intermediate shaft for gearbox without intarder	2-17	200337
2.16	Overview drawing, PTO intermediate shaft for gearbox with intarder	2-18	200337
2.17	Overview drawing, Z81 PTO, B version	2-19	200337
2.18	Overview drawing, Z81 PTO, C version	2-20	200337
2.19	Overview drawing, 2266 PTO, B version	2-21	200337
2.20	Overview drawing, 2266 PTO, C version	2-22	200337
2.21	Pneumatic diagram, PTO control	2-23	200337
3.	**INSPECTION AND ADJUSTMENT**	3-1	200337
3.1	Inspection and adjustment, DAF engine PTO prop shaft axial play	3-1	200337
3.2	Inspection and adjustment, axial play of drive sprockets in flywheel housing of DAF engine PTO	3-3	200337
3.3	Inspection and adjustment, axial play on gearbox output shaft without intarder with N221/10 PTO	3-5	200337
3.4	Inspection and adjustment, axial play of NL/1 PTO on N221/10 PTO	3-6	200337

13

		Page	Date
4.	**REMOVAL AND INSTALLATION**	4-1	200337
4.1	Removal and installation, entire DAF engine PTO on flywheel housing	4-1	200337
4.2	Removal and installation, DAF engine PTO flywheel housing	4-2	200337
4.3	Removal and installation, NH/1 and NL/1 PTO, B version	4-3	200337
4.4	Removal and installation, NH/1 and NL/1 PTO, C version	4-4	200337
4.5	Removal and installation, NH/4 and NL/4 PTO, B version	4-5	200337
4.6	Removal and installation, NH/4 and NL/4 PTO, C version	4-6	200337
4.7	Removal and installation, N221/10 PTO on gearbox without intarder	4-7	200337
4.8	Removal and installation, N221/10 PTO on gearbox with intarder	4-9	200337
4.9	Removal and installation, NL/1 PTO on N221/10 PTO	4-10	200337
4.10	Removal and installation, N AS/10 PTO	4-11	200337
4.11	Removal and installation, PTO intermediate shaft on gearbox without intarder	4-13	200337
4.12	Removal and installation, PTO intermediate shaft on gearbox with intarder	4-14	200337
4.13	Removal and installation, Z81 PTO, B version	4-15	200337
4.14	Removal and installation, Z81 PTO, C version	4-16	200337
4.15	Removal and installation, 2266 PTO, B version	4-17	200337
4.16	Removal and installation, 2266 PTO, C version	4-18	200337
5.	**DISASSEMBLY AND ASSEMBLY**	5-1	200337
5.1	Disassembly and assembly, DAF engine PTO	5-1	200337
5.2	Disassembly and assembly, DAF engine PTO housing	5-3	200337
5.3	Versions with and without drive flange and shift control	5-9	200337

1. SAFETY INSTRUCTIONS

To prevent skin injury, avoid unnecessary contact with the drained oil.

During work on the gearbox PTO, oil may flow from the gearbox. Collect this oil.

Never park a vehicle with the PTO engaged. In the case of air leakage, the pressure in the air system may drop, causing the PTO to switch off. During the gradual build-up of pressure in the air system, the PTO will also be re-engaged, which may result in the shifting teeth on the auxiliary gearbox shaft and the sleeve of the PTO being damaged beyond repair.

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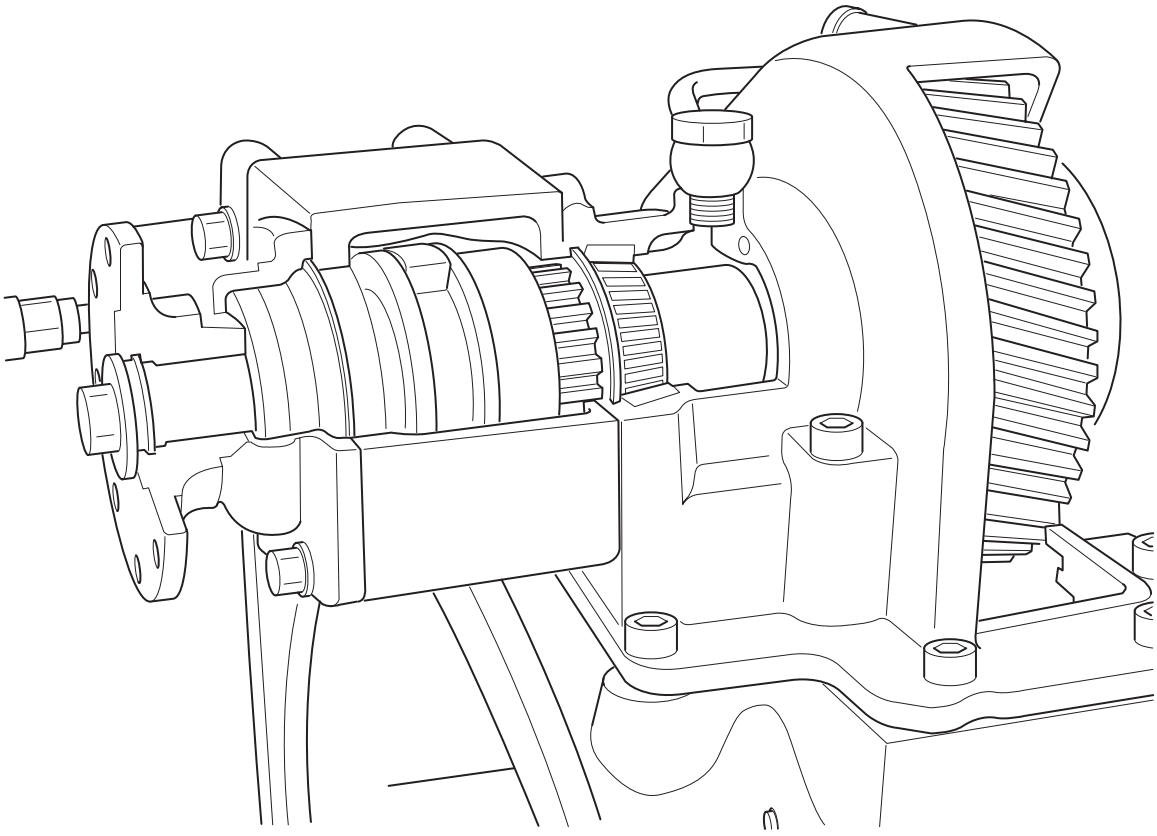
2. GENERAL

2.1 DAF ENGINE PTO DRIVE SIDE CROSS SECTION



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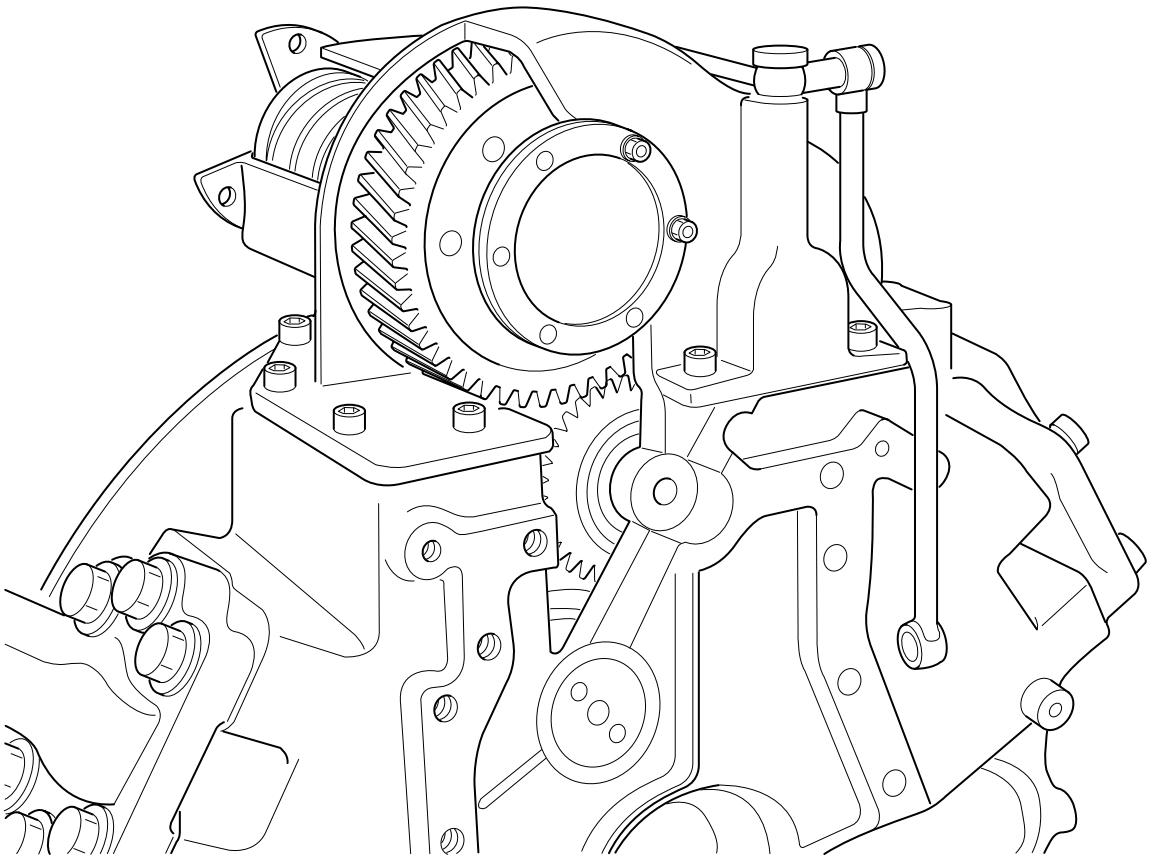
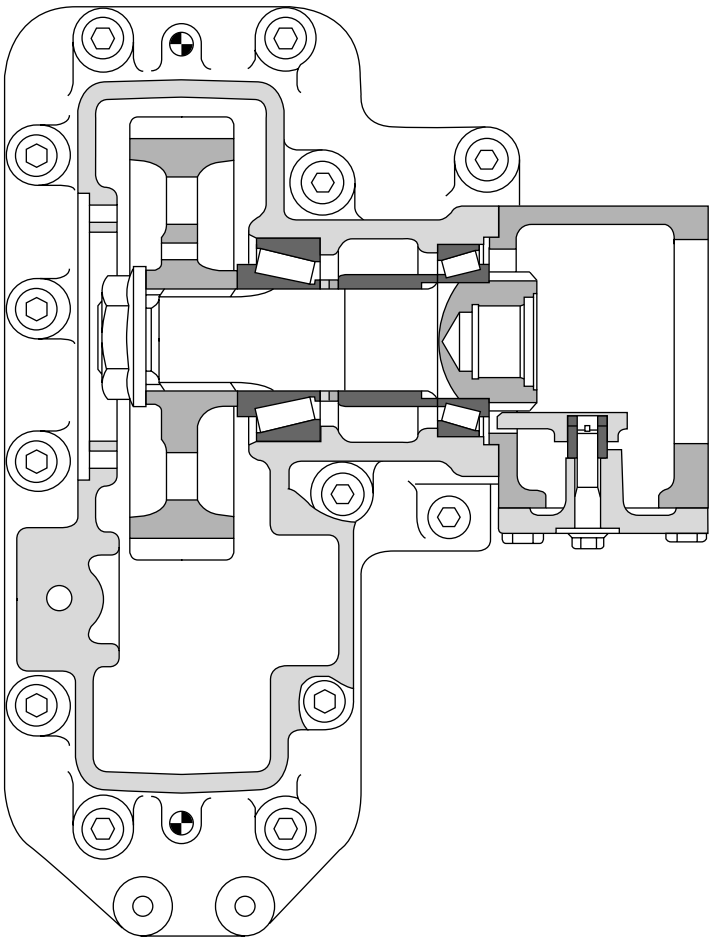
2.2 DAF ENGINE PTO ENGINE SIDE CROSS SECTION



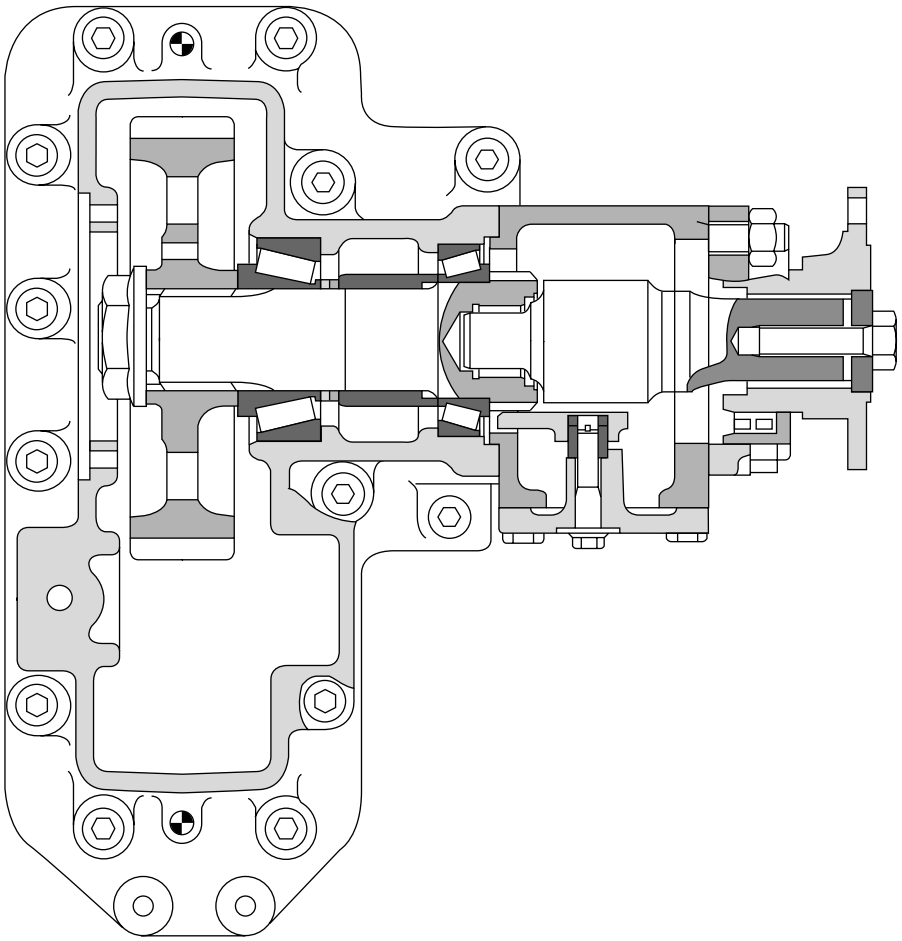
V300296

2.3 OVERVIEW DRAWINGS, DAF ENGINE PTO WITHOUT DRIVE FLANGE AND CONTROL



V300297

2.4 OVERVIEW DRAWINGS, DAF ENGINE PTO WITH DRIVE FLANGE AND WITHOUT CONTROL



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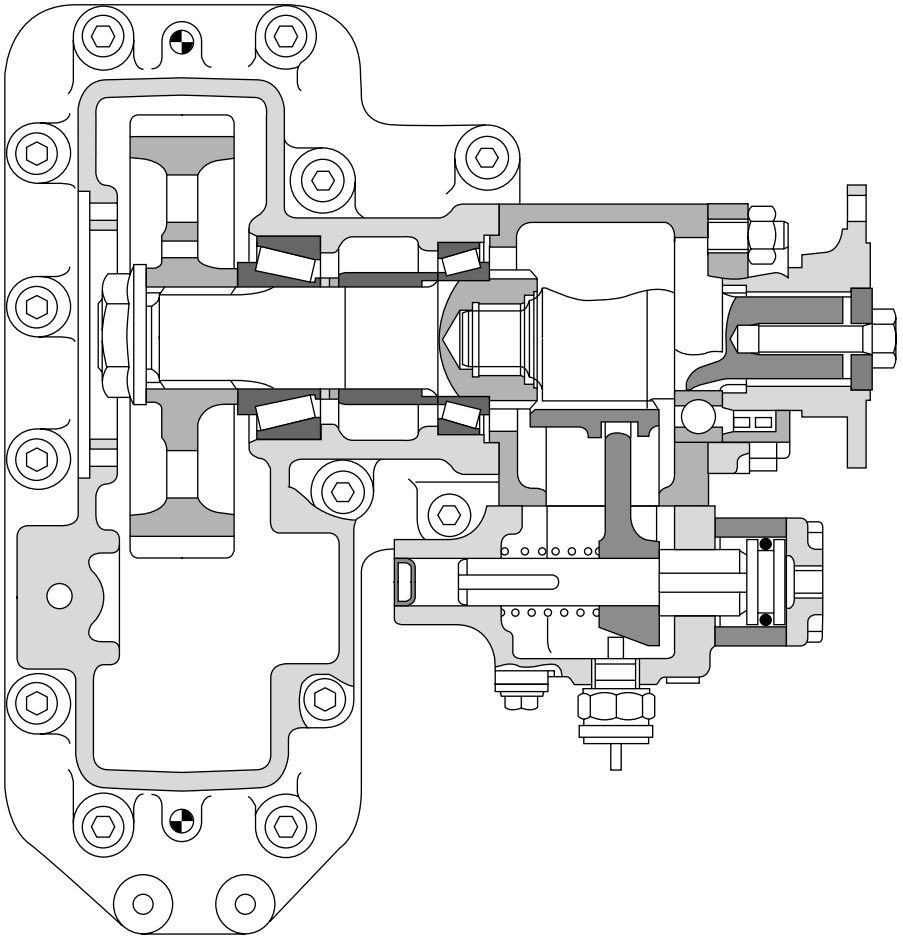
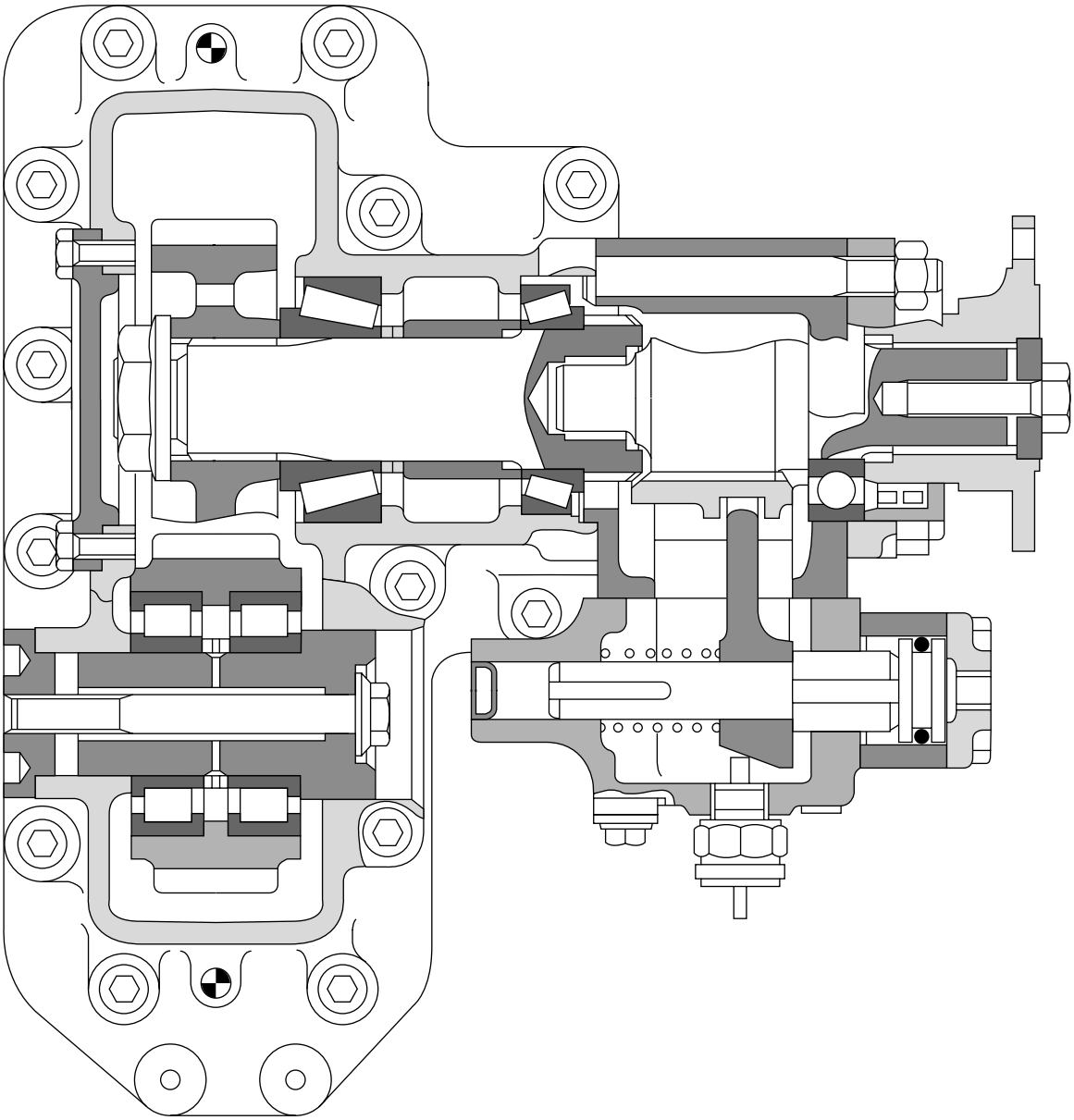
2.5 OVERVIEW DRAWINGS, DAF ENGINE PTO WITH DRIVE FLANGE AND CONTROL



V300298

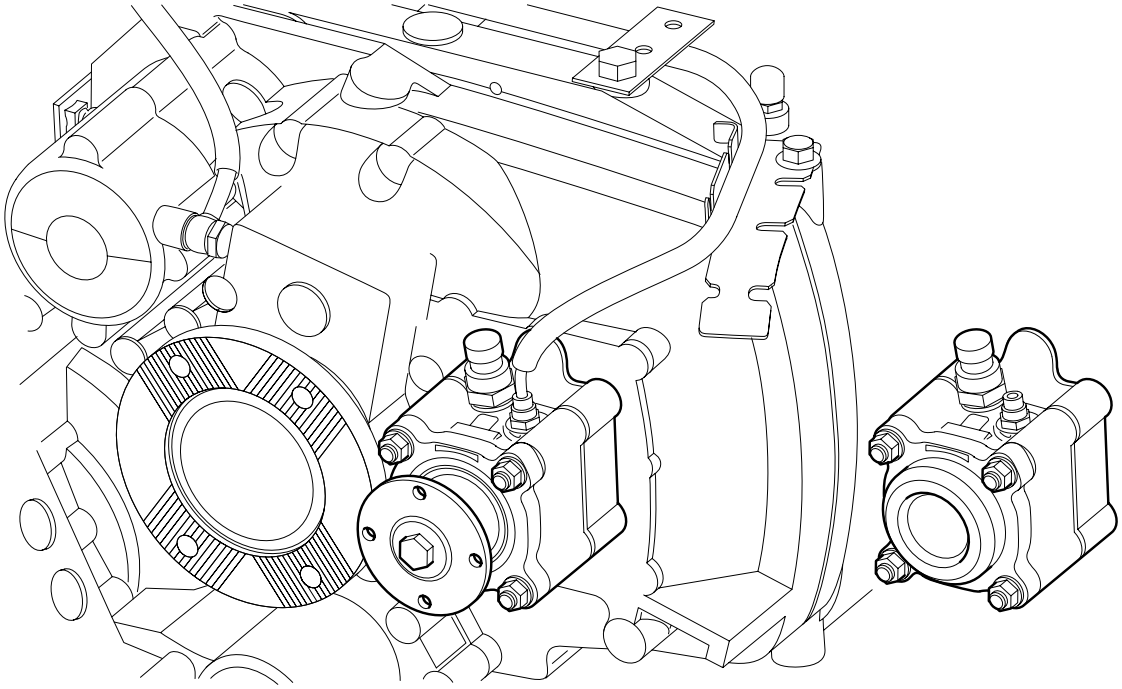
2.6 OVERVIEW DRAWINGS, DAF ENGINE PTO WITH THIRD GEAR WHEEL FOR OPPOSITE DRIVE FLANGE DIRECTION OF ROTATION



V300300

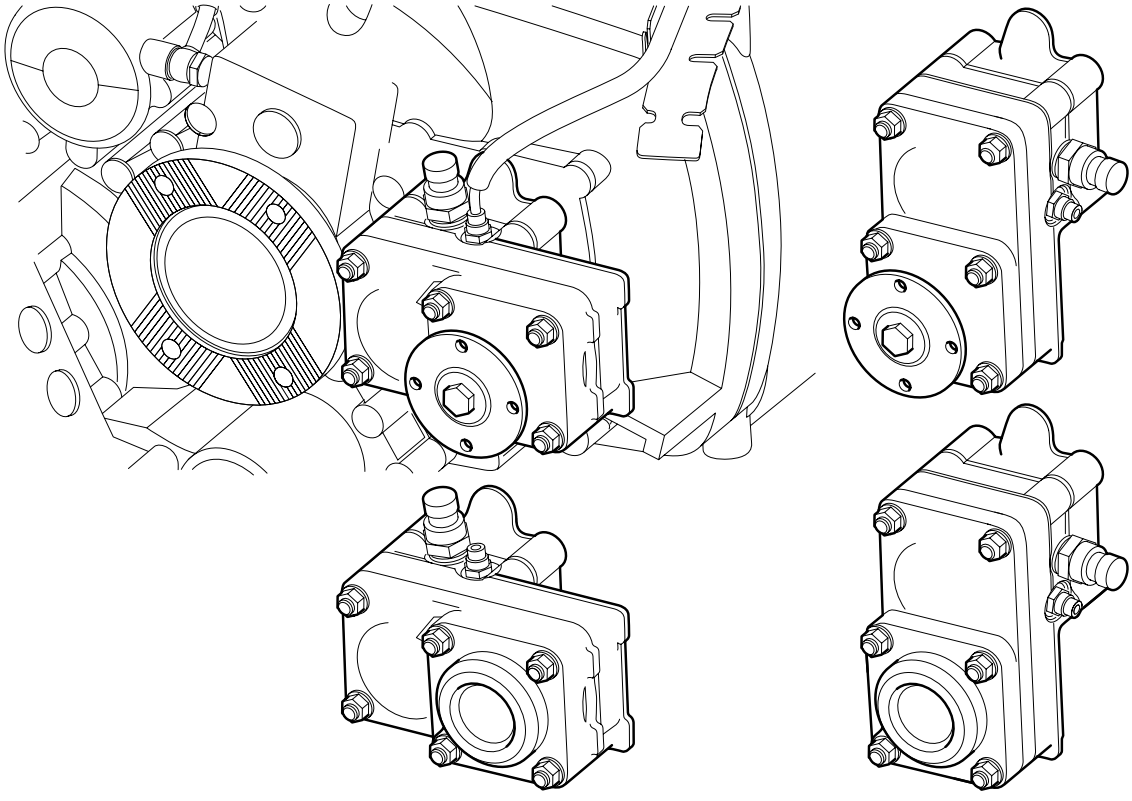
2.7 OVERVIEW DRAWINGS, PTO VERSIONS

NL/1 AND NH/1 VERSIONS



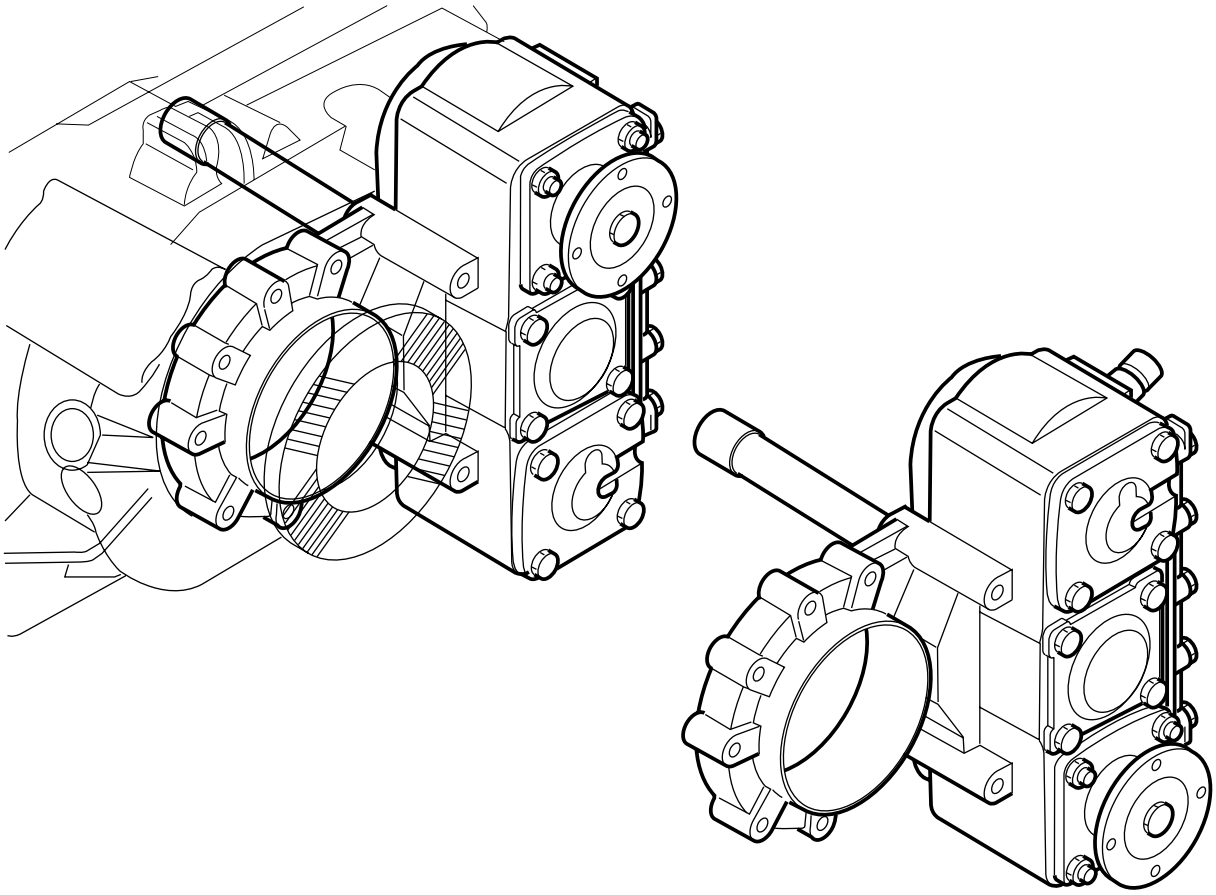
V300621

NL/4 AND NH/4 VERSIONS



V300622

N221/10 VERSION FOR GEARBOX WITHOUT INTARDER



V300213

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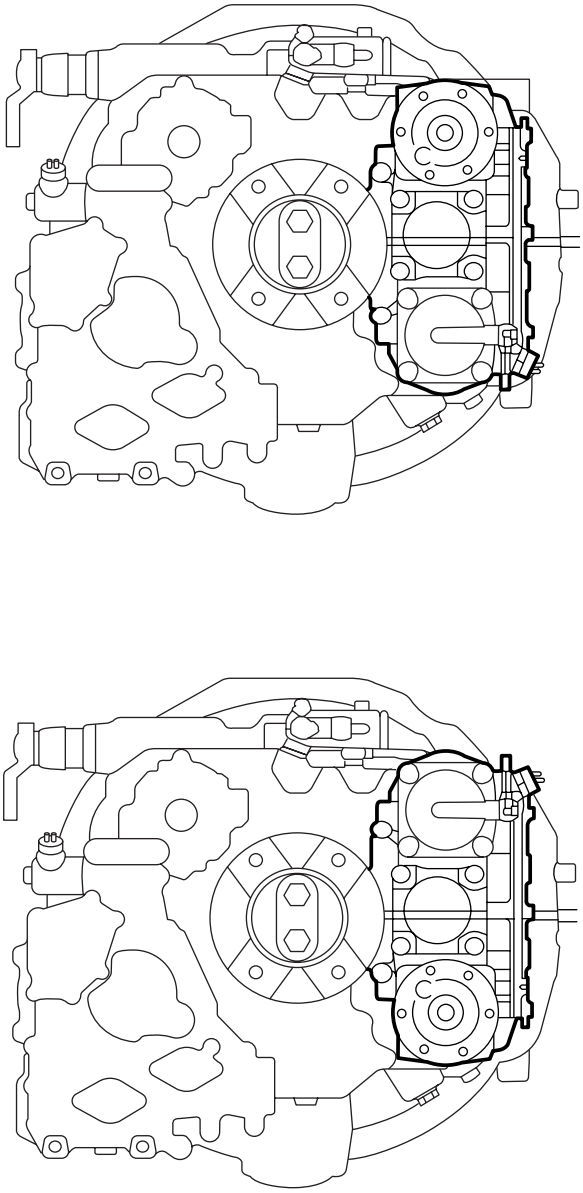
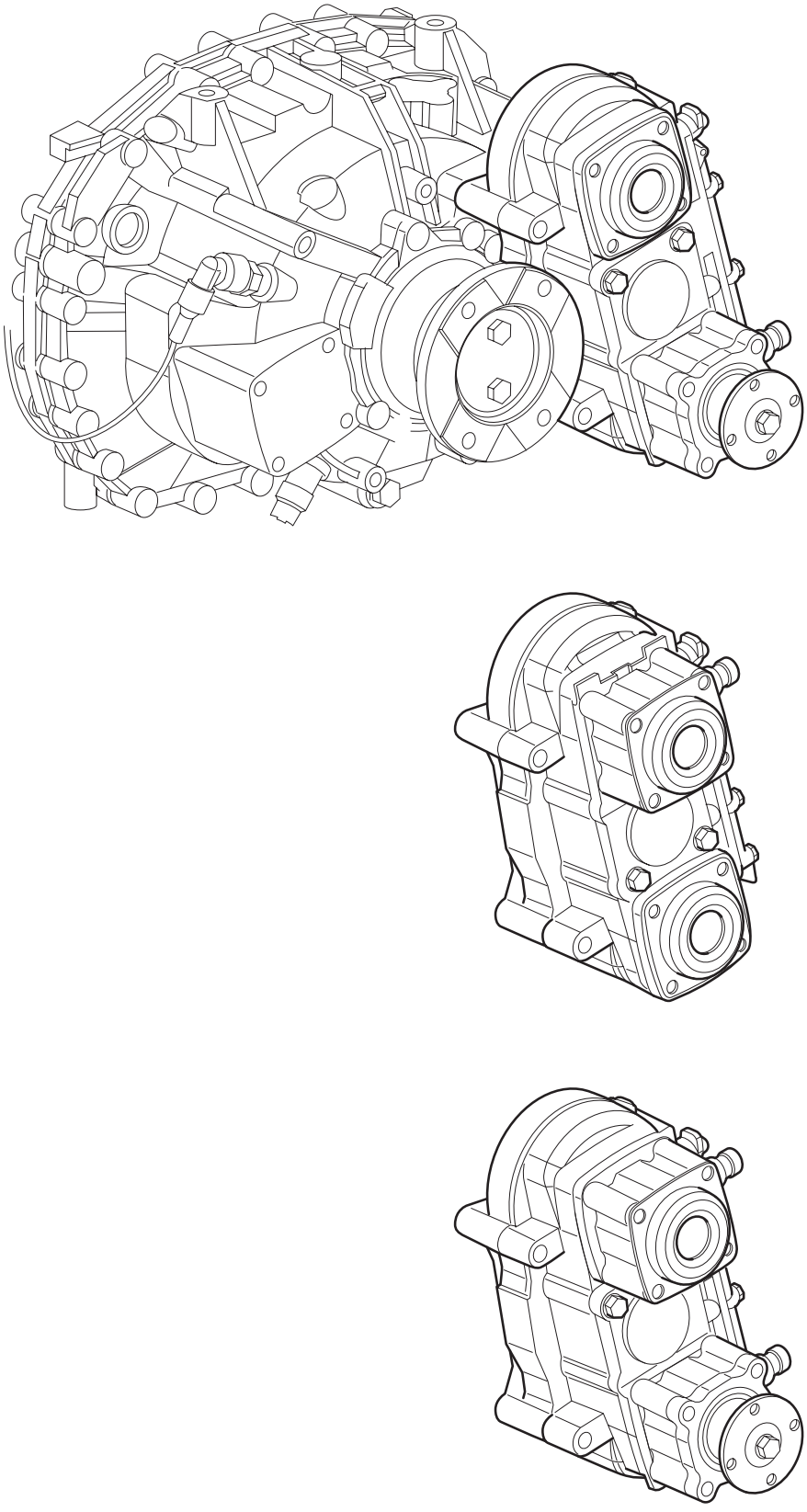
N221/10 VERSION FOR GEARBOX WITH INTARDER



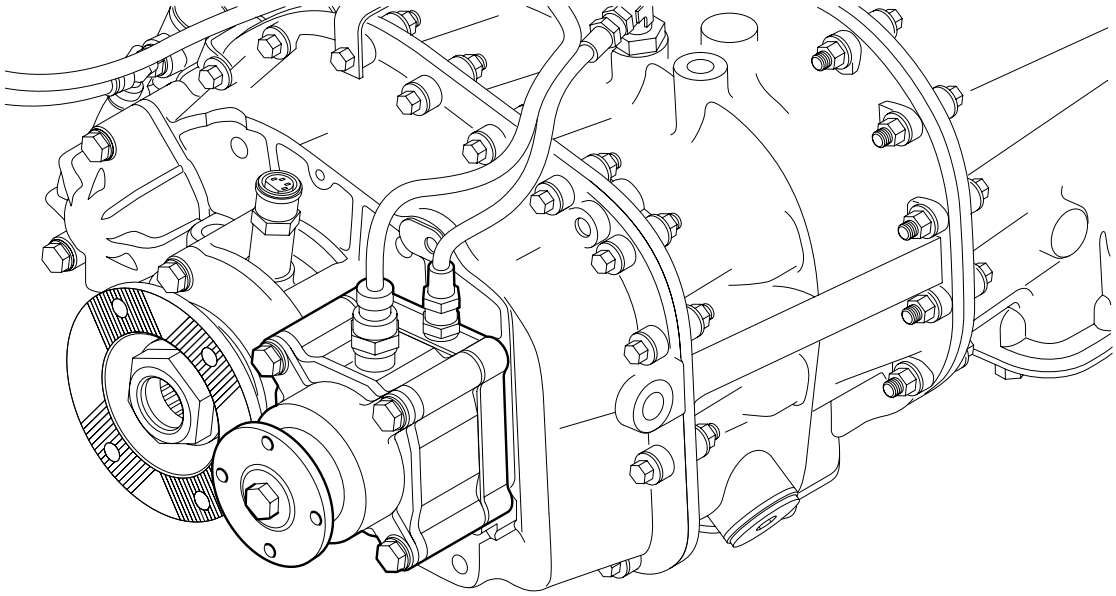
V300214

N AS/10 VERSION



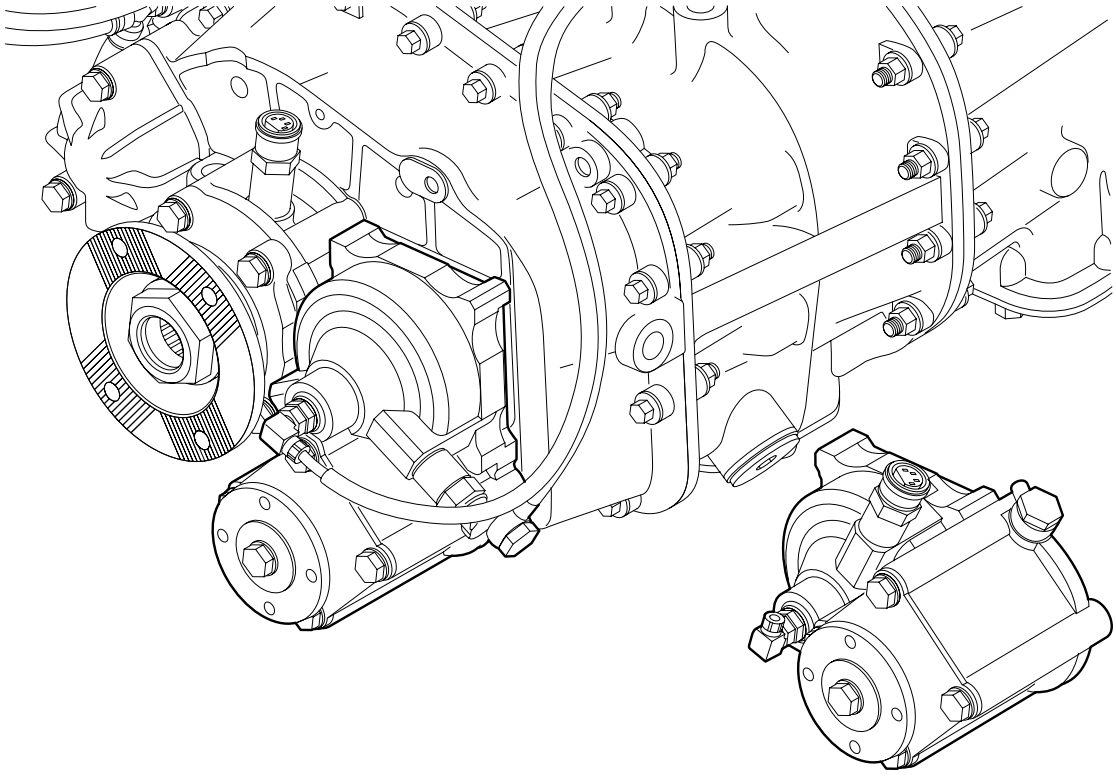
V300876

Z81 VERSION FOR EATON GEARBOX



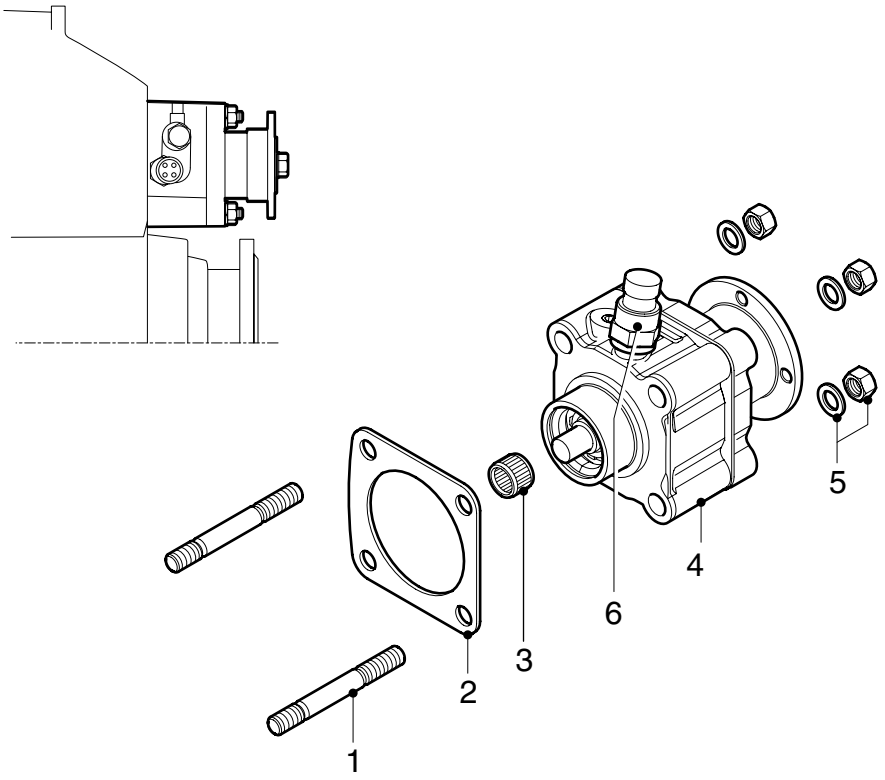
V300624

2266 VERSION FOR EATON GEARBOX



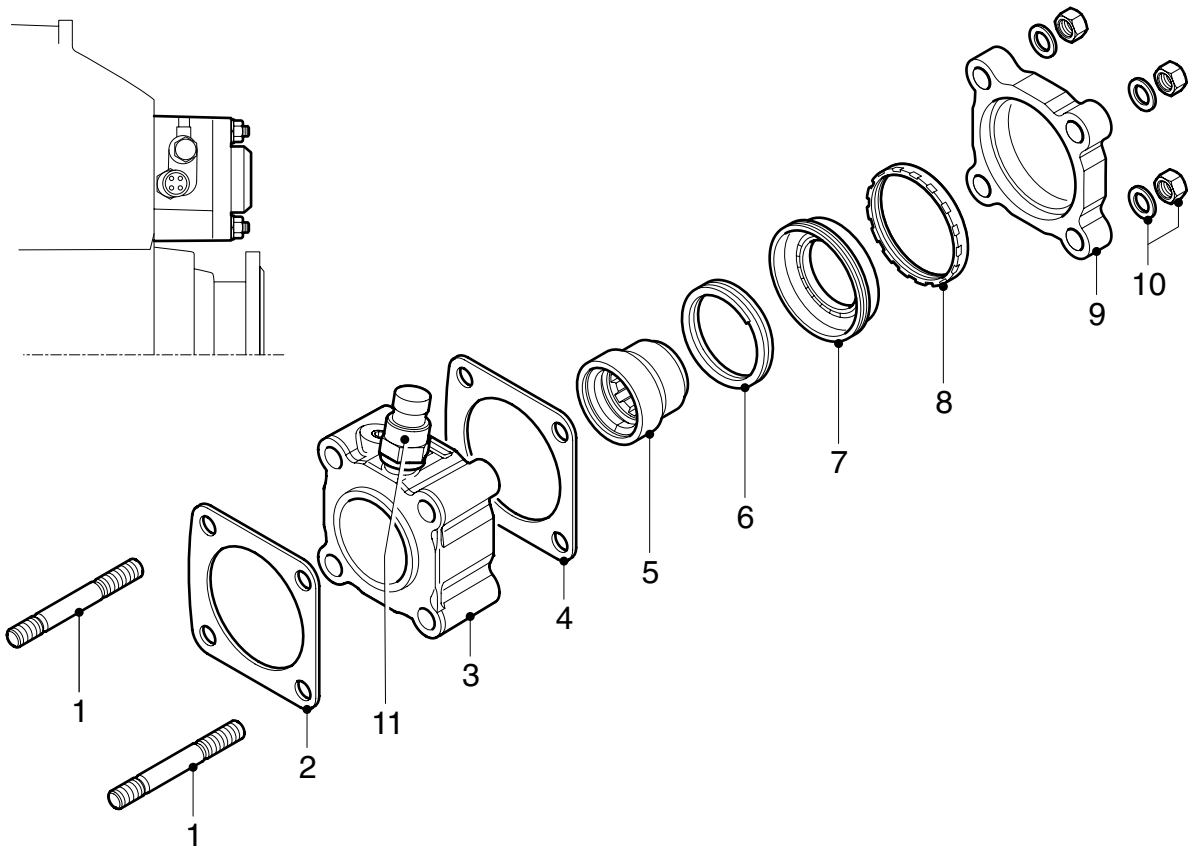
V300623

2.8 OVERVIEW DRAWING, NL/1 AND NH/1 PTO, B VERSION



1. Studs
2. Gasket
3. NH/1 needle bearing width 16 mm
   NL/1 needle bearing width 12 mm
4. PTO housing
5. Lock washer and nut
6. PTO control switch (depending on version, this may be of the reed switch type)

2.9 OVERVIEW DRAWING, NL/1 AND NH/1 PTO, C VERSION



1. Studs
2. Gasket
3. PTO housing
4. Gasket
5. Synchroniser sleeve
6. Spring
7. Piston
8. Centring ring
9. PTO-housing cover
10. Lock washer and nut
11. PTO control switch (depending on version, this may be of the reed switch type)

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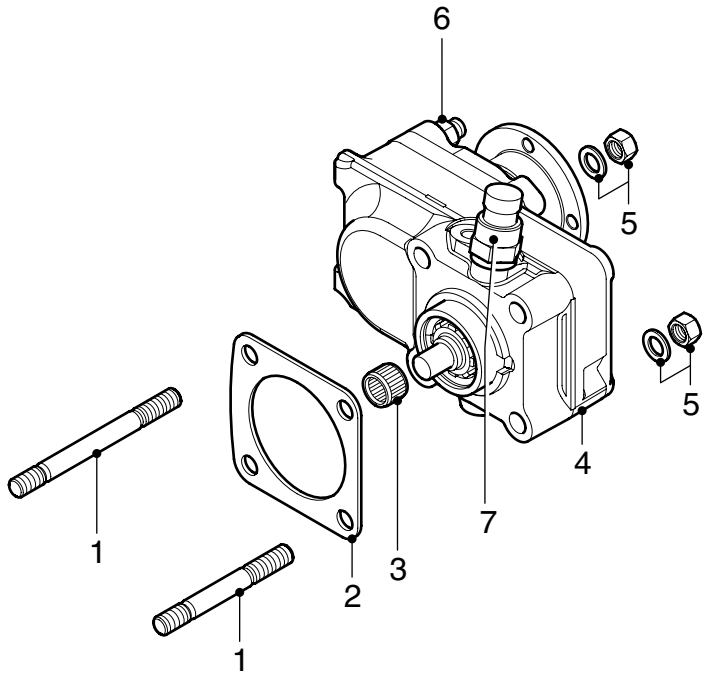
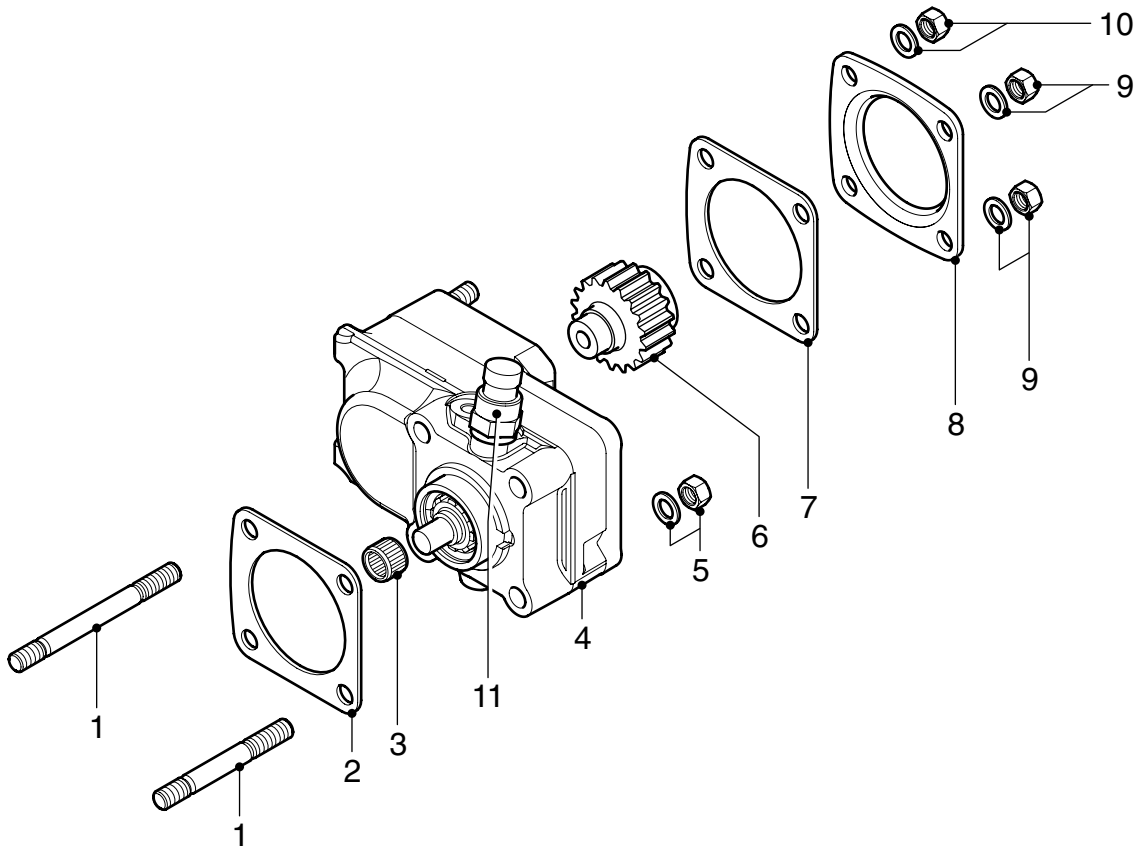
2.10 OVERVIEW DRAWING, NL/4 AND NH/4 PTO, B VERSION



V300874

1. Studs
2. Gasket
3. NH/4 needle bearing width 16 mm
   NL/4 needle bearing width 12 mm
4. PTO housing
5. Lock washer and nut
6. Lock washer and nut
7. PTO control switch (depending on version, this may be of the reed switch type)

2.11 OVERVIEW DRAWING, NL/4 AND NH/4 PTO, C VERSION

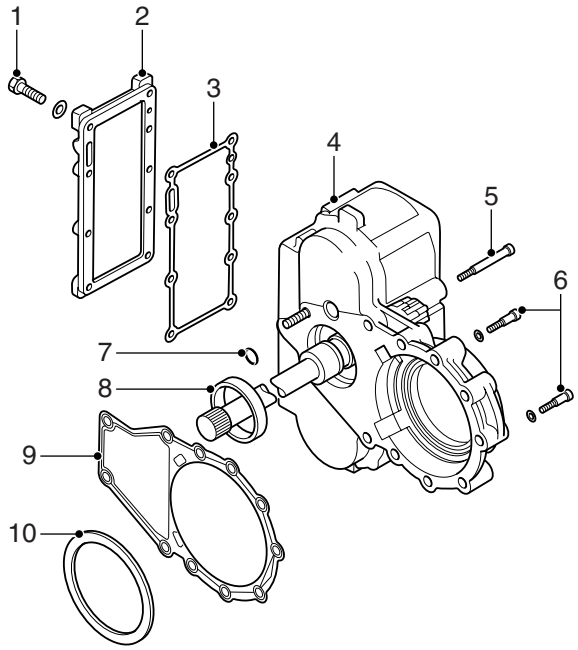


1. Studs
2. Gasket
3. NH/4 needle bearing width 16 mm
   NL/4 needle bearing width 12 mm
4. PTO housing
5. Lock washer and nut
6. Gear
7. Gasket
8. Transport cover
9. Lock washer and nut
10. Lock washer and nut
11. PTO control switch (depending on version, this may be of the reed switch type)

13

2.12 OVERVIEW DRAWING, N221/10 PTO ON GEARBOX WITHOUT INTARDER

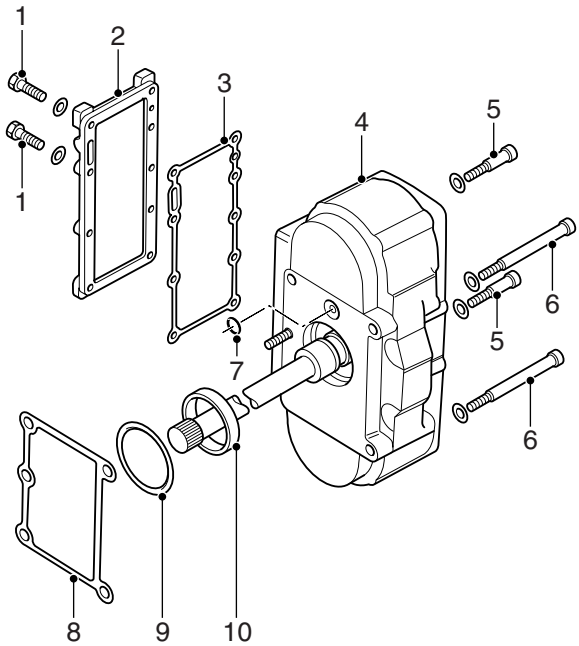
1. Side cover attachment bolts
2. Side cover
3. Gasket
4. PTO housing
5. Long attachment bolts
6. Short attachment bolts
7. O-ring
8. Centring ring
9. Gasket
10. Adjusting ring



V300221

2.13 OVERVIEW DRAWING, N221/10 PTO ON GEARBOX WITH INTARDER

1. Side cover attachment bolts
2. Side cover
3. Gasket
4. PTO housing
5. Short attachment bolts
6. Long attachment bolts
7. O-ring
8. Gasket
9. O-ring
10. Centring ring

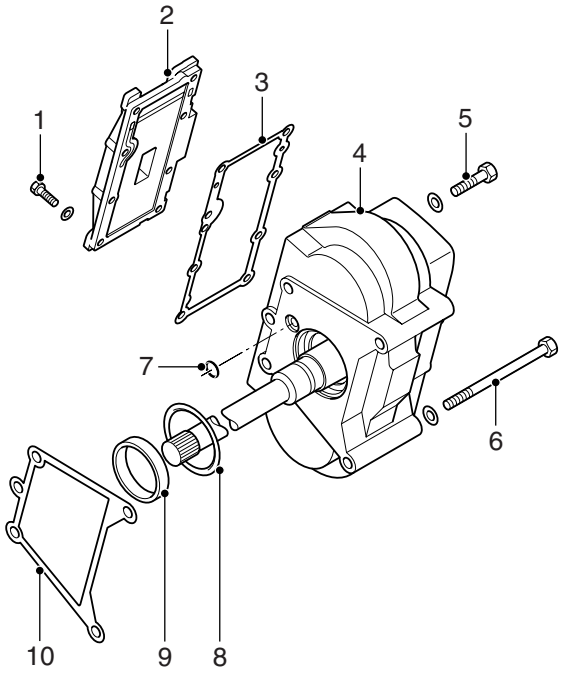


V300222

13

2.14 OVERVIEW DRAWING, N AS/10 PTO

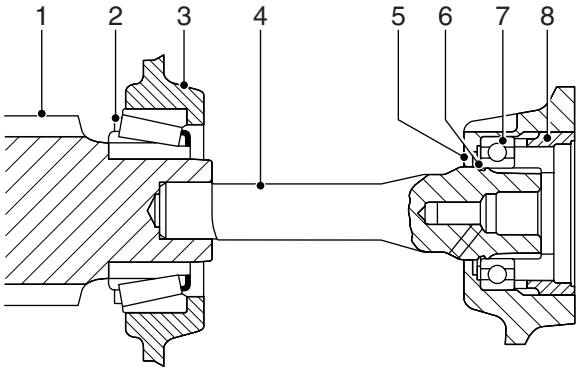
1. Side cover attachment bolts
2. Side cover
3. Gasket
4. PTO housing
5. Short attachment bolts
6. Long attachment bolts
7. O-ring
8. O-ring
9. Centring ring
10. Gasket



V300877

2.15 OVERVIEW DRAWING, PTO INTERMEDIATE SHAFT FOR GEARBOX WITHOUT INTARDER

1. Auxiliary shaft
2. Taper roller bearing
3. Gearbox housing
4. Intermediate shaft
5. Rear gearbox cover
6. Circlip
7. Ball bearing
8. Centring sleeve



V300223

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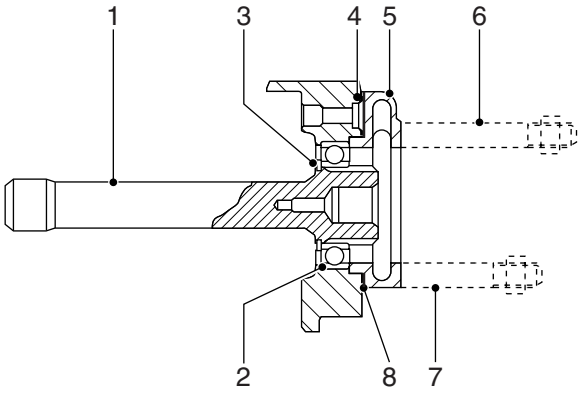
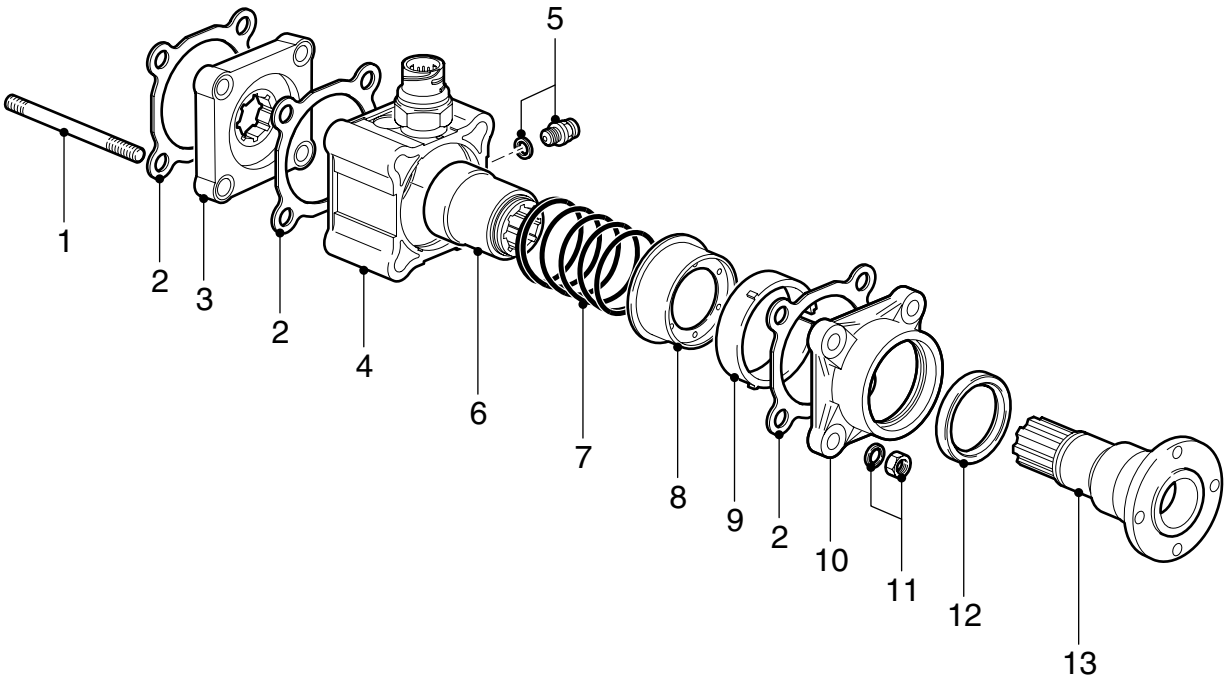
2.16 OVERVIEW DRAWING, PTO INTERMEDIATE SHAFT FOR GEARBOX WITH INTARDER

1. Intermediate shaft
2. Ball bearing
3. Circlip
4. O-ring
5. Intermediate housing
6. Long attachment bolt
7. Short attachment bolt
8. Gasket



2.17 OVERVIEW DRAWING, Z81 PTO, B VERSION

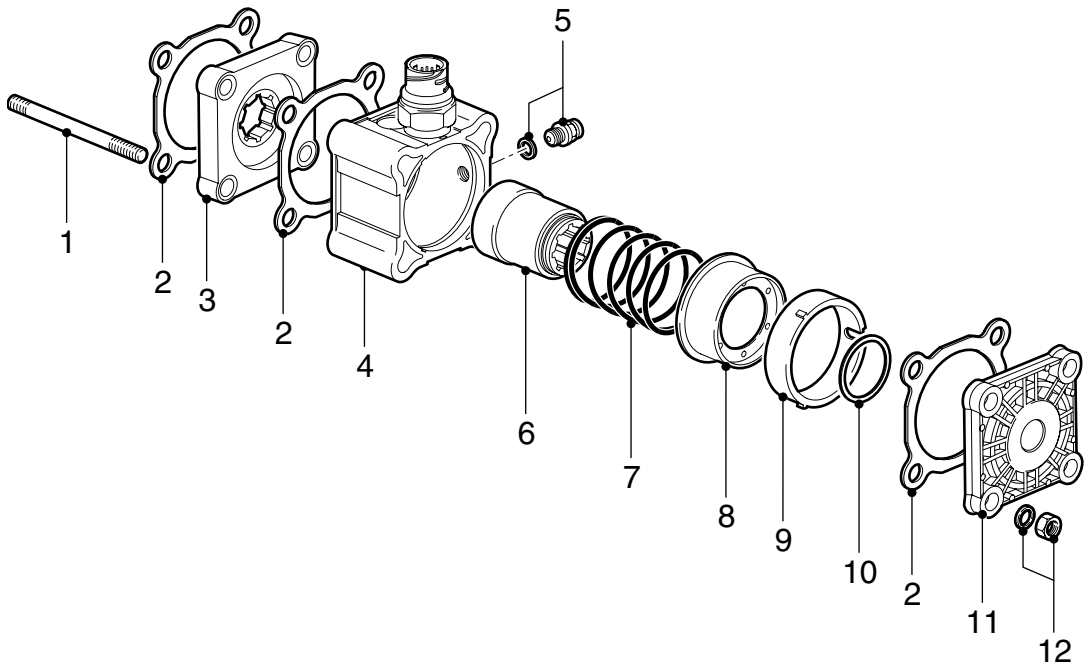


V300629

1. Stud
2. Gasket
3. Adapter plate, lubrication
4. PTO housing
5. Air connection
6. Synchroniser sleeve
7. Sleeve spring
8. Piston
9. Spacer ring
10. PTO housing cover
11. Lock washer and nut
12. Shaft seal
13. Drive flange

13

2.18 OVERVIEW DRAWING, Z81 PTO, C VERSION



1. Stud
2. Gasket
3. Adapter plate, lubrication
4. PTO housing
5. Air connection
6. Synchroniser sleeve
7. Sleeve spring
8. Piston
9. Spacer ring
10. Shim
11. Transport cover
12. Lock washer and nut

13

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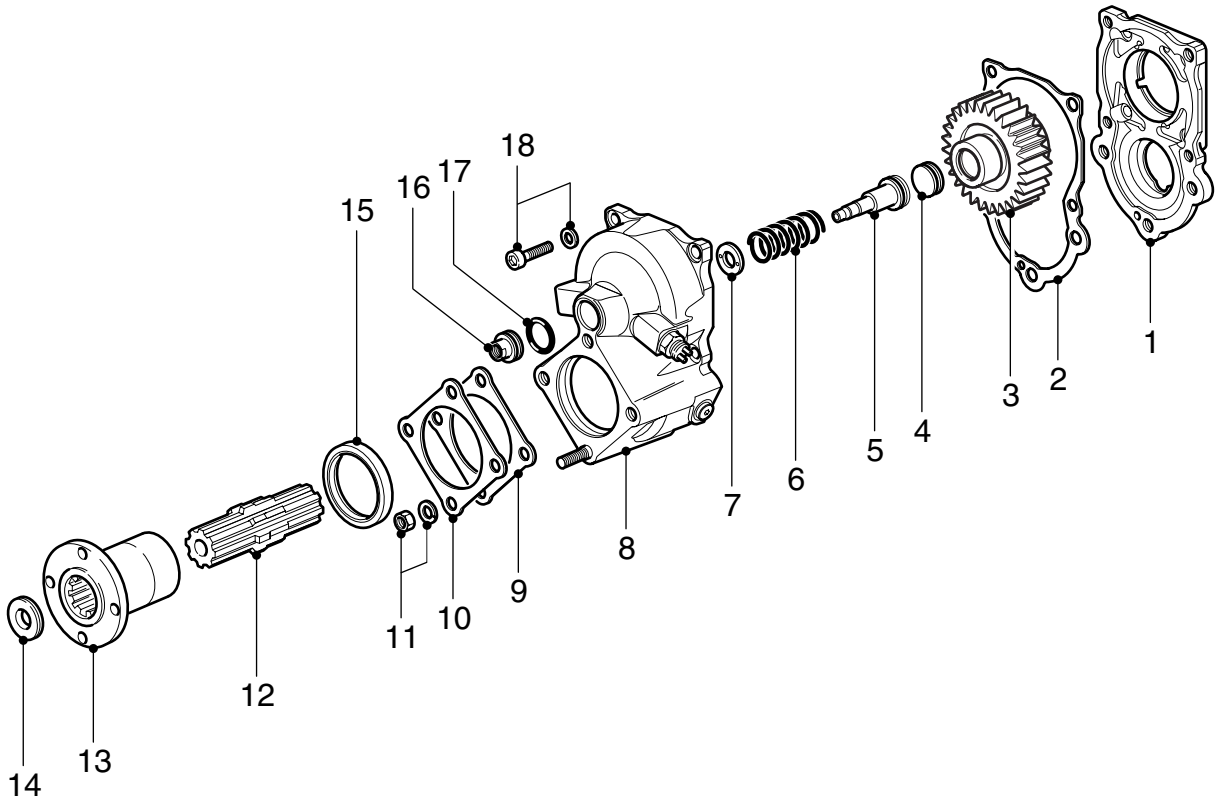
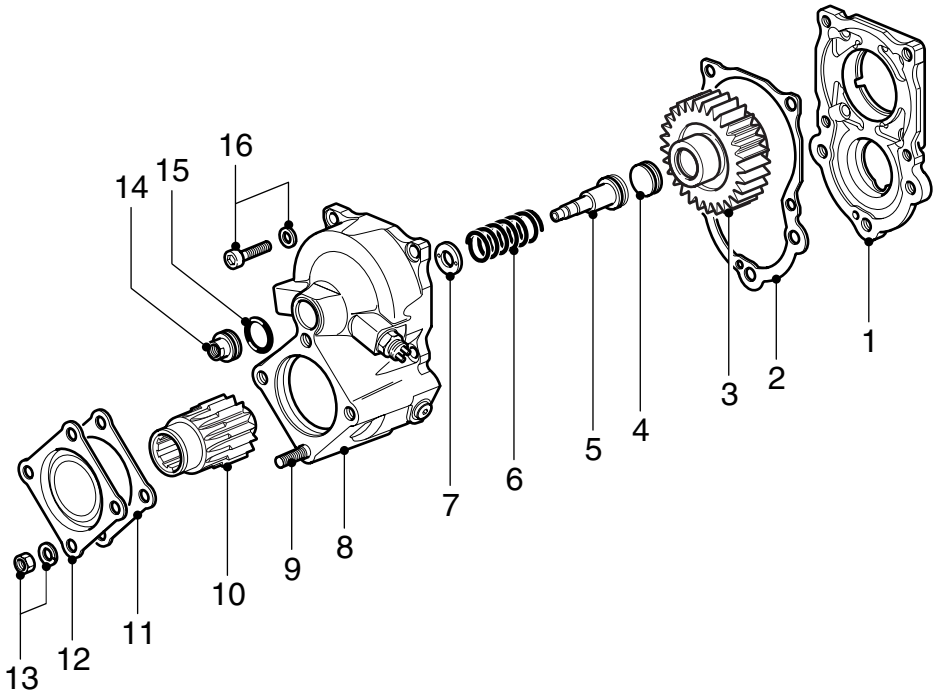
2.19 OVERVIEW DRAWING, 2266 PTO, B VERSION



1. PTO cover
2. Gasket
3. Drive sprocket
4. Spacer ring
5. Piston
6. Spring
7. Shim
8. PTO housing
9. Gasket
10. PTO cover
11. Lock washer and nut
12. Output shaft
13. Drive flange
14. Locking plate
15. Shaft seal
16. Air connection
17. O-ring
18. Lock washer and bolt

13

2.20 OVERVIEW DRAWING, 2266 PTO, C VERSION



1. PTO cover
2. Gasket
3. Drive sprocket
4. Spacer ring
5. Piston
6. Spring
7. Shim
8. PTO housing
9. Bolt
10. Output shaft
11. Gasket
12. Transport cover
13. Lock washer and nut
14. Air connection
15. O-ring
16. Lock washer and bolt

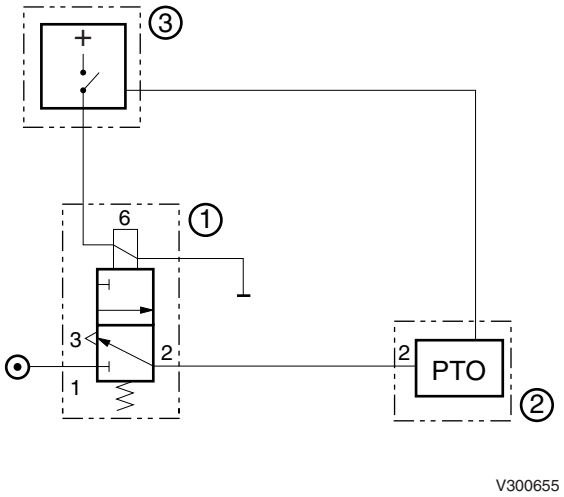
2.21 PNEUMATIC DIAGRAM, PTO CONTROL

Description
Depending on the version, the electropneumatic valve (1) is controlled by a switch or a combination of a switch and GV pressure sensor located in the cab. By operating the PTO control switch, voltage is applied to the VIC electronic unit (3). This voltage can also come from the engine speed control application connector.

Depending on the programmed switching conditions, the VIC applies voltage to the electropneumatic valve (1).

Upon activation of the electropneumatic valve (1), there is system pressure on the PTO connection, causing the PTO (2) to be activated. These switching conditions may be changed with DAVIE.

When the PTO (2) is switched on, the PTO control switch is activated and the VIC receives the feedback that the PTO is switched on mechanically.



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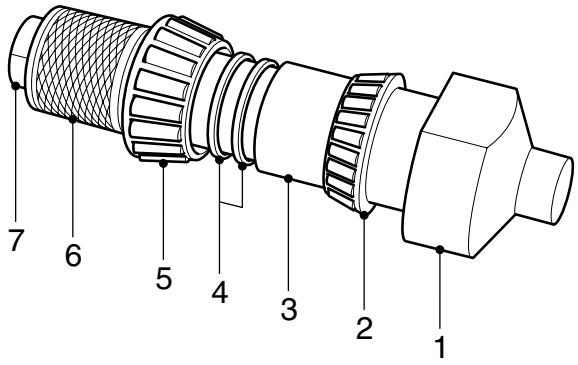
3. INSPECTION AND ADJUSTMENT

3.1 INSPECTION AND ADJUSTMENT, DAF ENGINE PTO PROP SHAFT AXIAL PLAY

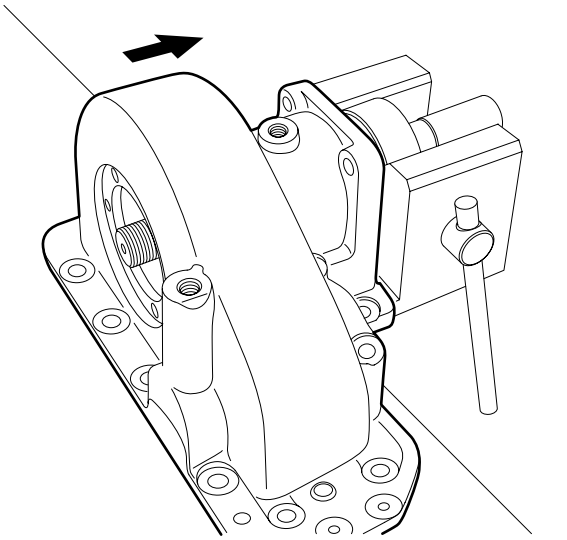
Inspection and adjustment, DAF engine PTO prop shaft axial play

1. Press the two outer bearing races into the PTO housing.
2. Fit the inner bearing (2) onto the engine PTO driving tool (1) (special tool, DAF No. 1329341).



V300633

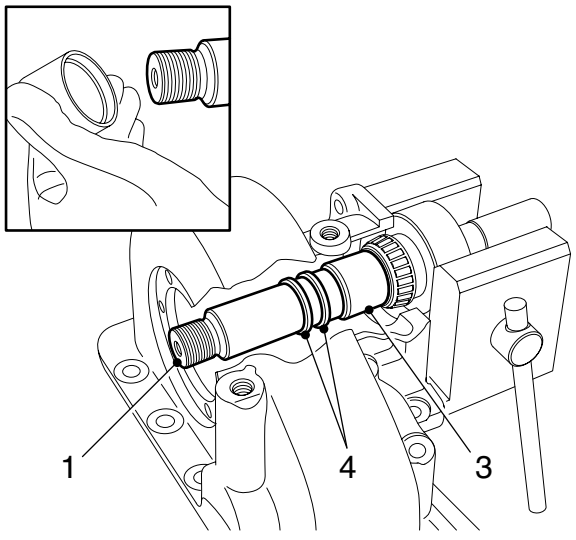
3. Fit the driving tool with the flat sides firmly secured in a vice.
4. Slide the PTO housing properly over the driving tool.


V300634

5. Fit the filler sleeve (3) and 2 shims (4) properly onto the driving tool (1).

   Take note of the reconditioned rim in the filler sleeve (3).

   Note:
   Use the driving tool to determine the correct assembly of the filler sleeve and shims.



V300635

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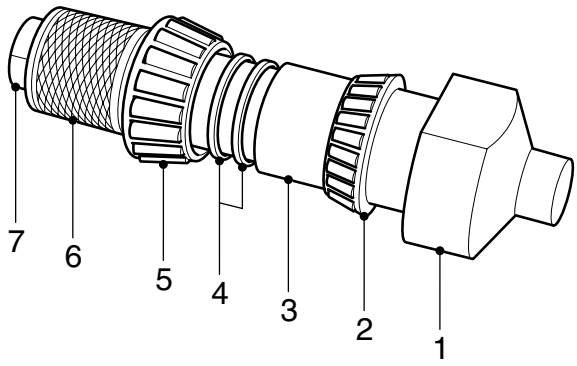
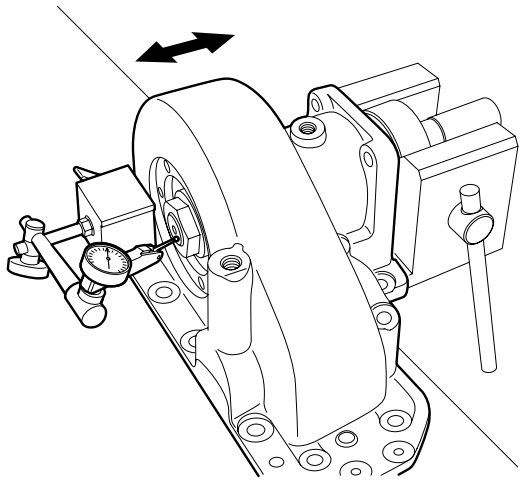
6. Fit the inner bearing (5) and the knurled sleeve (6) onto the driving tool (the knurled sleeve is used to simulate the PTO gearwheel).
7. Fit the lock nut (7) and tighten to the specified torque. See “Technical data”.



V300633

8. Place the dial gauge holder onto the PTO housing and allow the stylus of the dial gauge to rest on the driving tool.
9. Check the bearing play by moving the PTO housing up and down relative to the clamped driving tool in the axial direction. See “Technical data”.

   Note:
   Select the proper shim if the axial play is incorrect.
10. Disassemble the driving tool fully when the correct shim thickness has been established. See “Technical data”.


V300656

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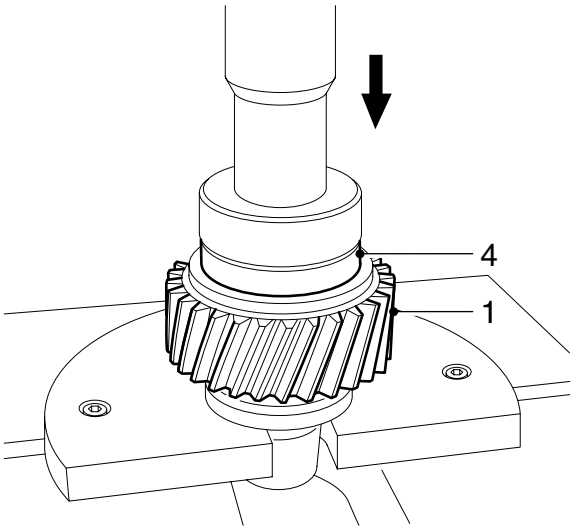
3.2 INSPECTION AND ADJUSTMENT, AXIAL PLAY OF DRIVE SPROCKETS IN FLYWHEEL HOUSING OF DAF ENGINE PTO

Inspection and adjustment, axial play of drive sprockets in flywheel housing

Note:
The procedures apply to both sets of drive sprockets.

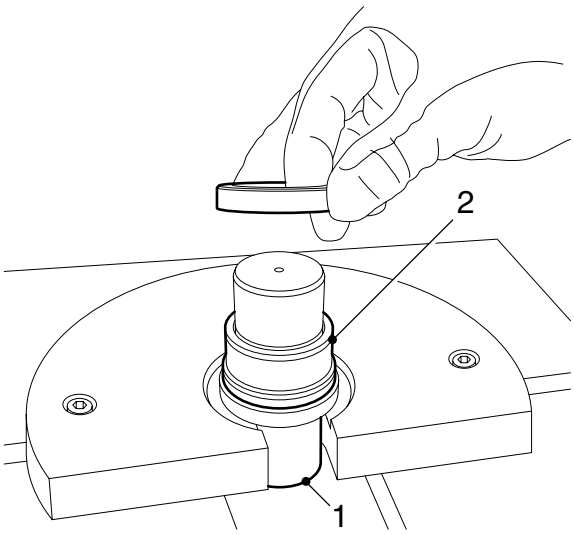
1. Press both outer bearing races (4) into the drive sprocket (1).



V300637

2. On one side of the drive sprocket, mount the inner bearing race.
3. Place the drive sprocket on the inner race on a driving tool underneath a press.

   Note:
   The external diameter of the driving tool (1) and the diameter of the inner bearing race (2) must be the same.
   Furthermore, when the play is checked, the shims must remain centred on the inner race.



V300641

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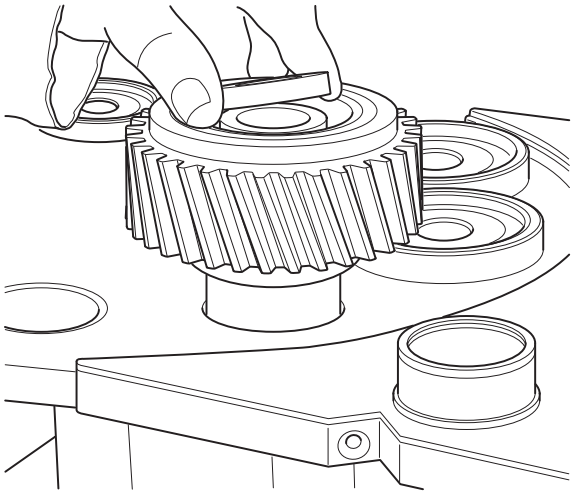
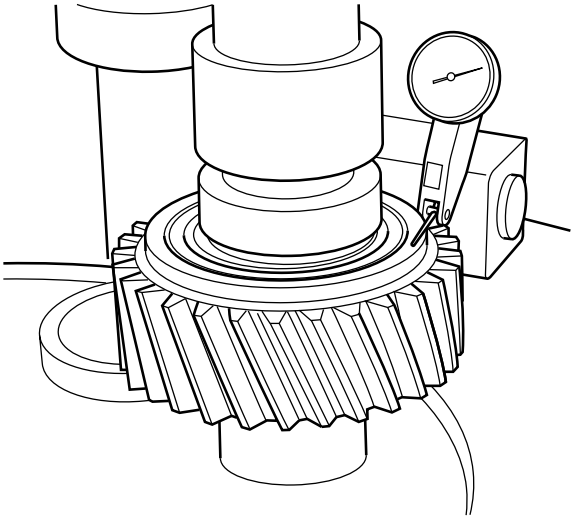
4. Starting with the thickest, place two shims on the inner race and fit the second inner bearing race.
5. Place another driving tool on the inner race and tighten it to a pressure of 1–5 tons.



V300305

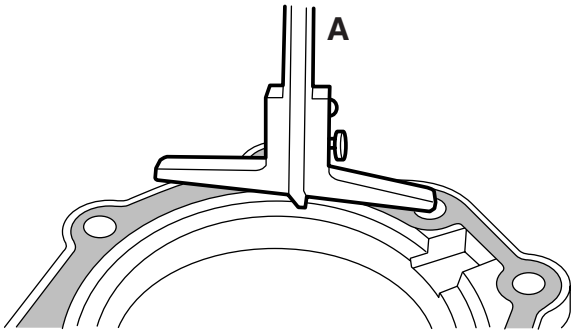
6. Place a dial gauge on the drive sprocket and inspect the axial play. See “Technical data”.
   If the axial play is too great or too little, choose the correct shim.
7. Put both gear shafts and the drive sprocket assembly aside to fit them later.



V300306

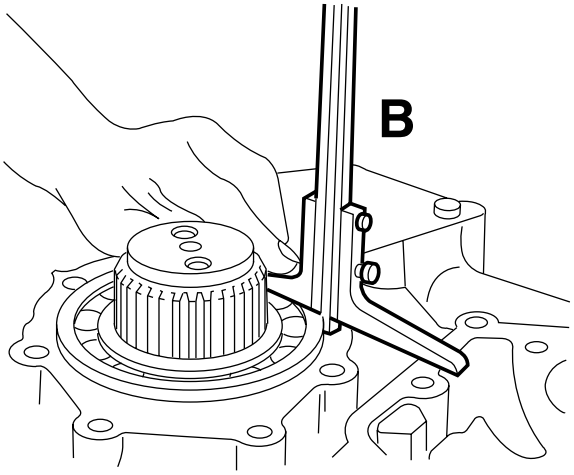
3.3 INSPECTION AND ADJUSTMENT, AXIAL PLAY ON GEARBOX OUTPUT SHAFT WITHOUT INTARDER WITH N221/10 PTO

1. Remove the bearing cover of the output shaft from the gearbox.
2. Install a new gasket on the bearing cover of the PTO housing. Use a depth gauge to determine the depth of the bearing cover recess, distance **A**.



V300227

3. Use a depth gauge to determine the height the ball bearing protrudes above the gearbox housing, distance **B**.
4. Calculate the axial play. The axial play equals distance **A** – distance **B**.
5. Compare the calculated value with the maximum allowable axial play. See “Technical data”.
6. If necessary, adjust the axial play by means of another shim.



V300216

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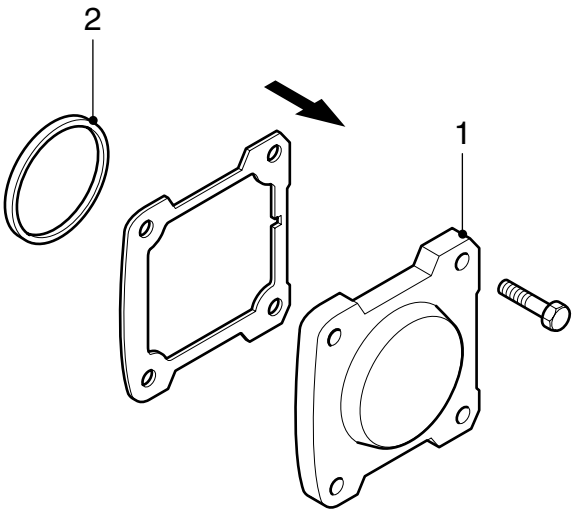
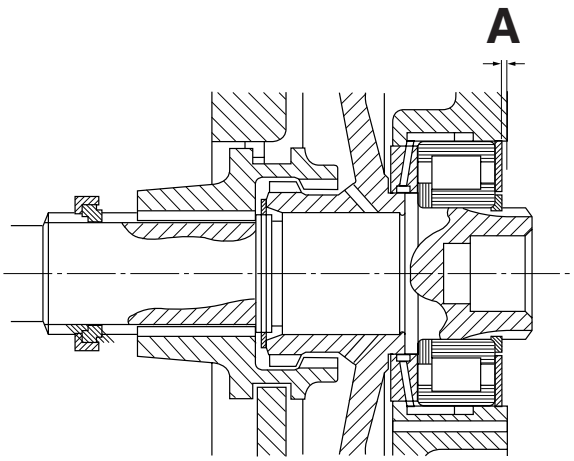
3.4 INSPECTION AND ADJUSTMENT, AXIAL PLAY OF NL/1 PTO ON N221/10 PTO

1. Remove the cover (1) and shim (2) of the N221/10 PTO.



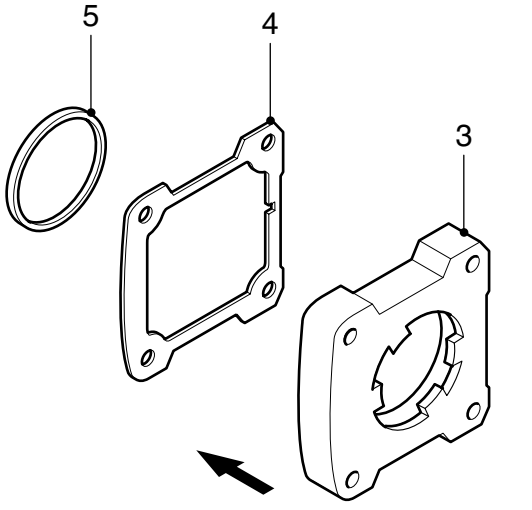
V300639

2. Use a depth gauge to measure the depth down to the outer bearing race, distance **A**.



V300230

3. Install a new gasket (4) in the intermediate housing (3).



V300640

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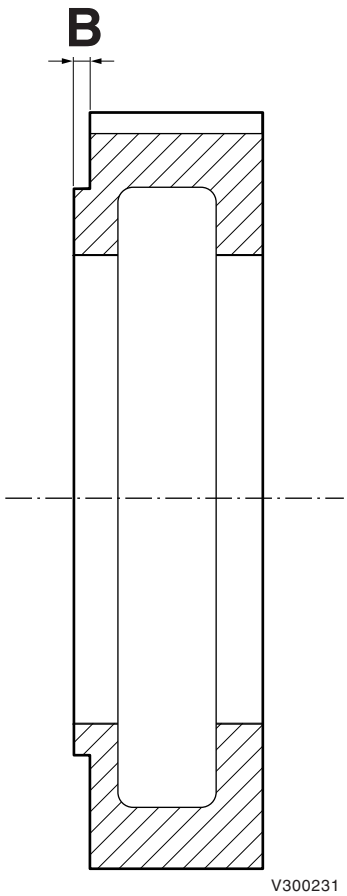
4. Use a depth gauge to determine the distance from the centring edge to the gasket, distance **B**.
   Calculate the axial play. The axial play equals distance **A** – distance **B**
5. Compare the calculated value with the maximum allowable axial play. See “Technical data”.
6. If necessary, adjust the axial play by means of another shim (5).



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4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION, ENTIRE DAF ENGINE PTO ON FLYWHEEL HOUSING

Removing entire DAF engine PTO on flywheel housing

1. If necessary, remove the prop shaft from the PTO flange.
2. Remove the banjo bolts from the engine PTO oil pipes.
3. If necessary, remove the electrical and air connections of the engine PTO.
4. Remove the attachment bolts of the entire PTO on the flywheel housing.
5. Remove the entire PTO from the flywheel housing.
6. Remove the PTO centring ring dowel pins from the flywheel housing.

Installing entire DAF engine PTO on flywheel housing

1. Fit the PTO centring ring dowel pins in the flywheel housing.
2. Install the entire PTO on the flywheel housing.
3. Fit the attachment bolts and tighten them to the specified torque. See “Technical data”.
4. Install the oil pipes and banjo bolts and tighten them to the specified torque. See “Technical data”.
5. If necessary, fit the electrical and air connections of the engine PTO.
6. If necessary, fit the prop shaft on the PTO flange.
7. Check the PTO operation.

4.2 REMOVAL AND INSTALLATION, DAF ENGINE PTO FLYWHEEL HOUSING

Removing DAF engine PTO flywheel housing

1. Remove the gearbox.
2. Remove the clutch release assembly and the flywheel.
3. Remove the PTO housing from the flywheel housing.
4. Remove the attachment bolt from the upper drive sprocket in the flywheel housing.
5. Suspend the engine in a hoist.
6. Suspend the clutch housing in a hoist.
7. Remove the engine bracket attachment bolts.
8. Remove the bolts attaching the flywheel housing to the engine block.
9. Remove the flywheel housing.
10. Remove the two drive sprockets from the flywheel housing. Be aware of the mounting position of the sprockets.
11. Remove the oil seal from the flywheel housing.

Installing DAF engine PTO flywheel housing

1. Fit a new oil seal in the flywheel housing.
2. Fit the two drive sprockets into the flywheel housing.
3. Install the flywheel housing and tighten the upper drive sprocket attachment bolt to the specified torque. See “Technical data”.
4. Fit the bolts attaching the flywheel housing to the engine block and tighten them to the specified torque. See “Technical data”.

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5. Fit the engine bracket attachment bolts.
6. Fit the entire PTO to the flywheel housing.
7. Fit the flywheel.
8. Fit the clutch release assembly.
9. Fit the gearbox.

4.3 REMOVAL AND INSTALLATION, NH/1 AND NL/1 PTO, B VERSION

Removing NH/1 and NL/1 PTO, B version

1. Drain as much gearbox oil as necessary and collect it in a clean container.
2. Remove the electrical connector and air pipe from the PTO.
3. Remove the drive flange, which is mounted against the PTO flange.
4. Remove the attachment nuts connecting the PTO to the gearbox and remove the PTO including needle bearing and gasket.
5. If necessary, remove the intermediate shaft.

Installing NH/1 and NL/1 PTO, B version

1. If necessary, install the intermediate shaft.
2. Install the gasket over the studs.
3. Install the PTO with needle bearing onto the gearbox.
4. Fit the attachment nuts onto the studs of the gearbox and the PTO.
5. Connect the electrical connector and air pipe to the PTO.
6. Install the drive flange against the PTO flange.
7. Check the oil level in the gearbox.

4.4 REMOVAL AND INSTALLATION, NH/1 AND NL/1 PTO, C VERSION

Removing NH/1 and NL/1 PTO, C version

1. Drain as much gearbox oil as necessary and collect it in a clean container.
2. Remove the electrical connector and air pipe from the PTO.
3. Remove the drive flange, which is mounted against the PTO flange.
4. Remove the attachment nuts connecting the PTO to the gearbox and remove the PTO including selector sleeve and gasket.
5. If necessary, remove the intermediate shaft.

Installing NH/1 and NL/1 PTO, C version

1. If necessary, install the intermediate shaft.
2. Install the gasket over the studs.
3. Install the PTO with selector sleeve onto the gearbox.
4. Fit the attachment nuts onto the studs of the gearbox and the PTO.
5. Connect the electrical connector and air pipe to the PTO.
6. Install the drive flange against the PTO flange.
7. Check the oil level in the gearbox.

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4.5 REMOVAL AND INSTALLATION, NH/4 AND NL/4 PTO, B VERSION

Removing NH/4 and NL/4 PTO, B version

1. Drain as much gearbox oil as necessary and collect it in a clean container.
2. Remove the electrical connector and air pipe from the PTO.
3. Remove the drive flange, which is mounted against the PTO flange.
4. Remove the attachment nuts connecting the PTO to the gearbox and remove the PTO including needle bearing and gasket.
5. If necessary, remove the intermediate shaft.

Installing NH/4 and NL/4 PTO, B version

1. If necessary, install the intermediate shaft.
2. Install the gasket over the studs.
3. Install the PTO with needle bearing onto the gearbox.
4. Fit the attachment nuts onto the studs of the gearbox and the PTO.
5. Connect the electrical connector and air pipe to the PTO.
6. Install the drive flange against the PTO flange.
7. Check the oil level in the gearbox.

4.6 REMOVAL AND INSTALLATION, NH/4 AND NL/4 PTO, C VERSION

Removing NH/4 and NL/4 PTO, C version

1. Drain as much gearbox oil as necessary and collect it in a clean container.
2. Remove the electrical connector and air pipe from the PTO.
3. Remove the drive flange, which is mounted against the PTO flange.
4. Remove the attachment nuts connecting the PTO to the gearbox and remove the PTO including selector sleeve and gasket.
5. If necessary, remove the intermediate shaft.

Installing NH/4 and NL/4 PTO, C version

1. If necessary, install the intermediate shaft.
2. Install the gasket over the studs.
3. Install the PTO with selector sleeve onto the gearbox.
4. Fit the attachment nuts onto the studs of the gearbox and the PTO.
5. Connect the electrical connector and air pipe to the PTO.
6. Install the drive flange against the PTO flange.
7. Check the oil level in the gearbox.

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4.7 REMOVAL AND INSTALLATION, N221/10 PTO ON GEARBOX WITHOUT INTARDER

Removing N221/10 PTO without intarder

1. Drain as much gearbox oil as necessary and collect it in a clean container.
2. Remove the electrical connector and air pipe from the PTO.
3. Remove the drive flange, which is mounted against the PTO flange.
4. Remove the attachment bolts from the PTO side cover and remove the side cover with the gasket.
5. Remove the gearbox drive shaft and hang the drive shaft on the side of the chassis.
6. Remove the bolts and lock plate from the drive flange.
7. **Note:**
   Measure and make a note of the distance from the drive flange to the shaft. The same distance must be observed when the drive flange is reinstalled.
8. Remove the drive flange and O-ring using a commercially available flange retainer and tripod puller.
9. Remove the attachment bolts from the bearing cover of the PTO and the two attachment bolts located on the inside of the PTO. Remove the entire PTO.
10. Remove the gasket, O-ring, centring ring and adjusting ring from the bearing of the output shaft.

Installing N221/10 PTO without intarder

1. Check the bearing play of the gearbox output shaft and adjust if necessary.
2. Install the O-ring and centring ring in the rear cover of the gearbox.
3. Fit a new gasket and adjusting ring in the rear cover of the PTO.
4. Install the PTO on the gearbox and fit the attachment bolts.
5. Fit a new gasket on the side cover of the PTO and fit the side cover.
6. Heat the gearbox drive flange to approximately 70°C. Slide the drive flange as far as possible onto the output shaft. Use a locking plate and two standard bolts (M12x75) to pull the drive flange further onto the shaft. Check the position of the drive flange on the basis of the above-mentioned measurement. Remove the locking plate and bolts.
7. Fit a new O-ring into the recess between the output shaft and the drive flange.
8. Hold the drive flange with a flange retainer.
9. Fit the lock plate with the bolts (M12x75) and tighten them to the specified torque. See “Technical data”.
10. Attach the prop shaft.
11. Connect the electrical connector and air pipe to the PTO.
12. Install the drive flange against the PTO flange.
13. Check the oil level in the gearbox.

4.8 REMOVAL AND INSTALLATION, N221/10 PTO ON GEARBOX WITH INTARDER

Removing N221/10 PTO with intarder

1. Drain as much gearbox oil as necessary and collect it in a clean container.
2. Remove the electrical connector and air pipe from the PTO.
3. Remove the drive flange, which is mounted against the PTO flange.
4. Remove the attachment bolts from the PTO side cover and remove the side cover with the gasket.
5. Remove the bolts attaching the PTO to the rear cover of the gearbox and the two attachment bolts on the inside of the PTO. Remove the entire PTO.
6. Remove the gasket, the O-ring and centring ring from the rear cover of the gearbox.

Installing N221/10 PTO with intarder

1. Install a new O-ring and centring ring in the rear cover of the gearbox.
2. Fit a new gasket to the rear cover of the gearbox.
3. Install the PTO.
4. Fit a new gasket on the side cover of the PTO and fit the side cover.
5. Connect the electrical connector and air pipe to the PTO.
6. Install the drive flange against the PTO flange.
7. Check the oil level in the gearbox.

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4.9 REMOVAL AND INSTALLATION, NL/1 PTO ON N221/10 PTO

Removing NL/1 PTO on N221/10 PTO

1. Drain as much gearbox oil as necessary and collect it in a clean container.
2. Remove the electrical connector and air pipe from the PTO.
3. Remove the drive flange, which is mounted against the PTO flange.
4. Remove the attachment bolts from the NL/1 PTO on the N221/10 PTO.
5. Remove the PTO, gasket and intermediate housing.

Installing NL/1 PTO on N221/10 PTO

1. Check and adjust the axial play before attaching the NL/1 PTO to the N221/10 PTO.
2. Fit a new gasket and the intermediate housing.
3. Install the PTO.
4. Connect the electrical connector and air pipe to the PTO.
5. Install the drive flange against the PTO flange.
6. Check the oil level in the gearbox.

4.10 REMOVAL AND INSTALLATION, N AS/10 PTO

Removing N AS/10 PTO on gearbox

1. Drain as much gearbox oil as necessary and collect it in a clean container.
2. Remove the electrical connector and air pipe from the PTO.
3. Remove the drive flange, which is mounted against the PTO flange.
4. Remove the attachment bolts from the PTO side cover and remove the side cover with the gasket.
5. Remove the drive shaft from the gearbox and hang the drive shaft on the side of the chassis.
6. Hold the drive flange in place with the special tool (DAF No. 0484977).
7. Remove the attachment bolts from the drive flange.
8. Remove the bolts and the locking plate from the prop shaft flange.
9. **Note:**
   Measure and make a note of the distance from the drive flange to the shaft. The same distance must be observed when the drive flange is reinstalled.

   Remove the prop shaft flange and O-ring using a commercially available puller.
10. Remove the attachment bolts from the bearing cover of the PTO and the two attachment bolts located on the inside of the PTO. Remove the entire PTO.
11. Remove the gasket, both O-rings and, in the case of a gearbox with intarder, the centring ring too.

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Installing N AS/10 PTO

1. Grease both O-rings with petroleum jelly and fit them in the PTO housing.
2. In the case of a gearbox with intarder, place the centring ring in the gearbox.
3. Fit the new gasket on the PTO housing.
4. Install the PTO on the gearbox and fit the attachment bolts.
5. Tighten the PTO attachment bolts to the specified torque. See “Technical data”.
6. Fit a new gasket on the side cover of the PTO and fit the side cover.
7. Heat the gearbox prop shaft flange to approximately 70°C. Slide the prop shaft flange as far as possible onto the output shaft. Use a locking plate and two standard bolts (M12x75) to pull the prop shaft flange further onto the shaft. Check the position of the prop shaft flange on the basis of the above-mentioned measurement. Remove the locking plate and bolts.
8. Fit a new O-ring into the recess between the output shaft and the prop shaft flange.
9. Hold the drive flange in place with the special tool (DAF No. 0484977).
10. **Note:**
    Bolts that will be re-used must be cleaned and lightly oiled.

    Fit the locking plate and tighten the attachment bolts to the specified torque. See “Technical data”.
11. Attach the prop shaft.
12. Connect the electrical connector and air pipe to the PTO.
13. Install the drive flange against the PTO flange.
14. Check the oil level in the gearbox.

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4.11 REMOVAL AND INSTALLATION, PTO INTERMEDIATE SHAFT ON GEARBOX WITHOUT INTARDER

Removing intermediate shaft without intarder

1. Drain as much gearbox oil as necessary and collect it in a clean container.
2. Remove the PTO.
3. Remove the centring sleeve.
4. Remove the intermediate shaft with bearing and circlip from the rear cover of the gearbox.
5. Remove the circlip and the intermediate shaft bearing, if necessary.

Installing intermediate shaft without intarder

1. **Note:**
   The intermediate shaft can be installed without any measurements being taken.

   Install the bearing and the circlip on the intermediate shaft.
2. Install the intermediate shaft in the rear cover of the gearbox.
3. Install the centring sleeve on the rear cover of the gearbox.
4. Install the PTO.
5. Check the oil level in the gearbox.

4.12 REMOVAL AND INSTALLATION, PTO INTERMEDIATE SHAFT ON GEARBOX WITH INTARDER

Removing intermediate shaft with intarder

1. Drain as much gearbox oil as necessary and collect it in a clean container.
2. Remove the PTO.
3. Remove the intermediate housing from the rear cover of the gearbox.
4. Remove the O-ring and the gasket.
5. Remove the intermediate shaft with bearing and circlip from the rear cover of the gearbox.
6. Remove the circlip and the intermediate shaft bearing.

Installing intermediate shaft with intarder

1. **Note:**
   The intermediate shaft can be installed without any measurements being taken.

   Install the bearing and the circlip on the intermediate shaft.
2. Install the intermediate shaft in the rear cover of the gearbox.
3. Install the intermediate housing with O-ring and gasket onto the rear cover of the gearbox.
4. Install the PTO.
5. Check the oil level in the gearbox.

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4.13 REMOVAL AND INSTALLATION, Z81 PTO, B VERSION

Removing Z81 PTO, B version

1. Drain as much gearbox oil as necessary and collect it in a clean container.
2. Remove the lubricating oil pipe, electrical connector and air pipe from the PTO.
3. Remove the drive flange, which is mounted against the PTO flange.
4. Remove the attachment nuts connecting the PTO to the gearbox and remove the PTO including adapter plate and gaskets.
5. If necessary, remove the intermediate shaft.

Installing Z81 PTO, B version

1. If necessary, install the intermediate shaft.
2. Fit the gaskets and adapter plate over the studs.
3. Install the PTO on the gearbox.
4. Fit the attachment nuts onto the studs of the gearbox and the PTO.
5. Fit the lubricating oil pipe, the electrical connector and air pipe to the PTO.
6. Install the drive flange against the PTO flange.
7. Check the oil level in the gearbox.

4.14 REMOVAL AND INSTALLATION, Z81 PTO, C VERSION

Removing Z81 PTO, C version

1. Drain as much gearbox oil as necessary and collect it in a clean container.
2. Remove the lubricating oil pipe, electrical connector and air pipe from the PTO.
3. Remove the drive flange, which is mounted against the PTO flange.
4. Remove the attachment nuts connecting the PTO to the gearbox and remove the PTO including adapter plate and gaskets.
5. If necessary, remove the intermediate shaft.

Installing Z81 PTO, C version

1. If necessary, install the intermediate shaft.
2. Fit the gaskets and adapter plate over the studs.
3. Install the PTO on the gearbox.
4. Fit the attachment nuts onto the studs of the gearbox and the PTO.
5. Fit the lubricating oil pipe, the electrical connector and air pipe to the PTO.
6. Install the drive flange against the PTO flange.
7. Check the oil level in the gearbox.

4.15 REMOVAL AND INSTALLATION, 2266 PTO, B VERSION

Removing 2266 PTO, B version

1. Drain as much gearbox oil as necessary and collect it in a clean container.
2. Remove the lubricating oil pipe, electrical connector and air pipe from the PTO.
3. Remove the drive flange, which is mounted against the PTO flange.
4. Remove the attachment bolts connecting the PTO to the gearbox and remove the PTO including gasket.
5. If necessary, remove the intermediate shaft.

Installing 2266 PTO, B version

1. If necessary, install the intermediate shaft.
2. Fit the gasket over the attachment bolts of the PTO.
3. Install the PTO on the gearbox.
4. Fit the lubricating oil pipe, the electrical connector and air pipe to the PTO.
5. Install the drive flange against the PTO flange.
6. Check the oil level in the gearbox.

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4.16 REMOVAL AND INSTALLATION, 2266 PTO, C VERSION

Removing 2266 PTO, C version

1. Drain as much gearbox oil as necessary and collect it in a clean container.
2. Remove the lubricating oil pipe, electrical connector and air pipe from the PTO.
3. Remove the drive flange, which is mounted against the PTO flange.
4. Remove the attachment bolts connecting the PTO to the gearbox and remove the PTO including gasket.
5. If necessary, remove the intermediate shaft.

Installing 2266 PTO, C version

1. If necessary, install the intermediate shaft.
2. Fit the gasket over the attachment bolts of the PTO.
3. Install the PTO on the gearbox.
4. Fit the lubricating oil pipe, the electrical connector and air pipe to the PTO.
5. Install the drive flange against the PTO flange.
6. Check the oil level in the gearbox.

5. DISASSEMBLY AND ASSEMBLY

5.1 DISASSEMBLY AND ASSEMBLY, DAF ENGINE PTO

Disassembling drive sprockets from flywheel housing

1. Remove the lower drive sprocket attachment bolt and remove the sealing plate on the rear of the sprocket shaft.
2. Place the flywheel housing under a hand press and press the sprocket shaft of the lower drive sprocket out of the flywheel housing.

Note!
Before disassembling the drive sprockets, note the mounting direction in the flywheel housing. This is to ensure that the PTO housing fits when the gearwheels of the drive sprocket of the PTO housing are assembled.

3. Remove the drive sprocket with inner race and shim from the flywheel housing.
4. Similarly, remove the upper drive sprocket from the flywheel housing (the attachment bolt has already been taken out when the flywheel housing was removed).
5. If necessary, remove the inner race from the sprocket shaft.

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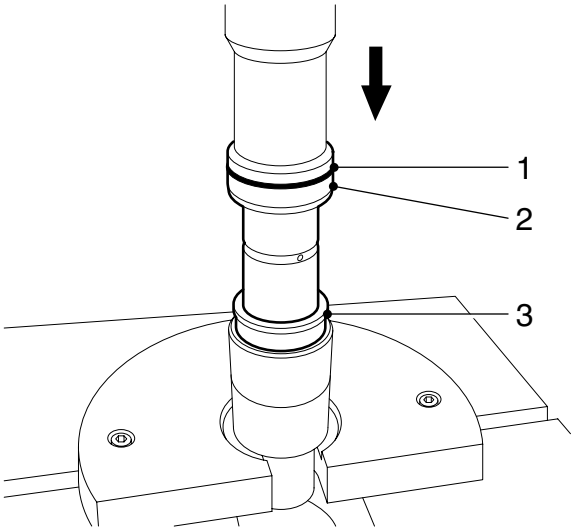
Mounting drive sprockets in flywheel housing

1. Check that both drive sprocket assemblies have correct bearing play.
2. Place the O-ring on the shaft.
3. Press an inner bearing race (3) onto the sprocket shaft (2) (oil the shaft).

   Note:
   Take proper note of the original mounting direction of the drive sprockets in the flywheel housing.
4. Place the flywheel housing under a hand press and put the drive sprocket assembly in the lower part of the flywheel housing.
5. Press the shaft through the flywheel housing into the drive sprocket until the shaft collar abuts the flywheel housing.
6. Mount the sealing plate on the rear of the flywheel housing.
7. Mount the O-ring on the attachment bolt, oil it lightly and tighten the bolt to the specified torque. See “Technical data”.
8. Repeat this for the top drive sprocket assembly.

   Note!
   The attachment bolt and O-ring are mounted together with the flywheel housing against the engine block.



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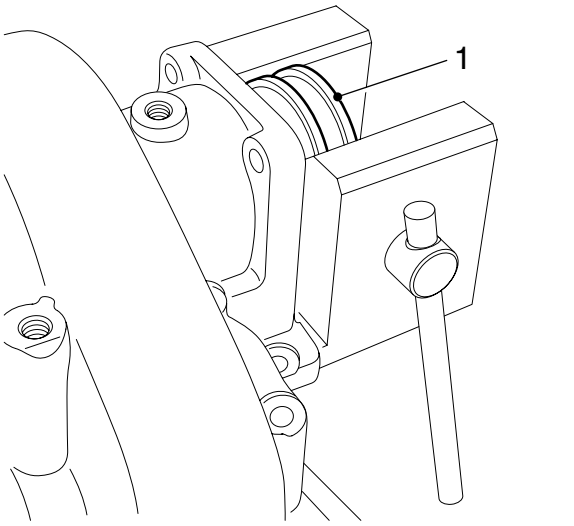
5.2 DISASSEMBLY AND ASSEMBLY, DAF ENGINE PTO HOUSING

Disassembly, DAF engine PTO housing

1. If fitted, remove the drive flange.
2. At the rear of the PTO housing, remove the sealing plate attachment bolts of the drive shaft with the gasket.
3. Place the engine PTO mounting ring (1) (special tool, DAF No. 1329342) on the drive shaft and clamp it firmly in a vice.
4. Remove the lock nut from the drive shaft.
5. If fitted, remove the pneumatic valve.
6. If fitted, remove the shift control.
7. Remove the drive housing attachment nuts and the drive-side cover with oil seal, if fitted.
8. If necessary, remove the short drive shaft with bearing and selector ring from the PTO housing.
9. Remove the prop shaft from the PTO housing with the adjusting rings and drive sprocket.
10. If necessary, remove the needle bearing for the short drive shaft from the prop shaft.
11. If necessary, remove the two outer bearing races from the PTO housing.
12. If necessary, remove the bearing from the prop shaft.



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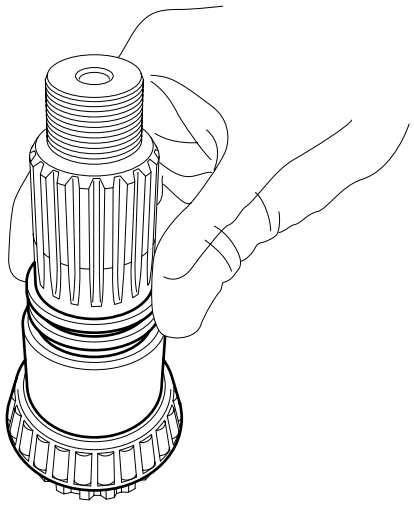
Assembly, DAF engine PTO housing

1. If necessary, press the two outer bearing races into the PTO housing.
2. If necessary, press the inner bearing onto the prop shaft.
3. Fit the assembly consisting of inner races, filler sleeve and shims (made earlier with the aid of the driving tool) onto the prop shaft (take note of the position of the filler sleeve relative to the prop shaft: the reconditioned rim must point towards the bearing).



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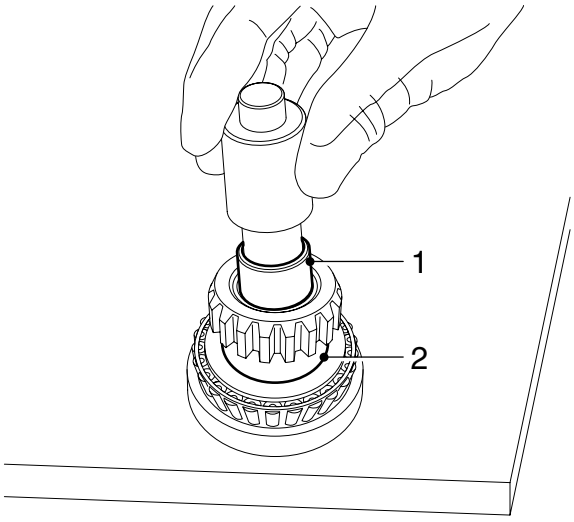
4. If necessary, fit the needle bearing for the short drive shaft into the prop shaft.



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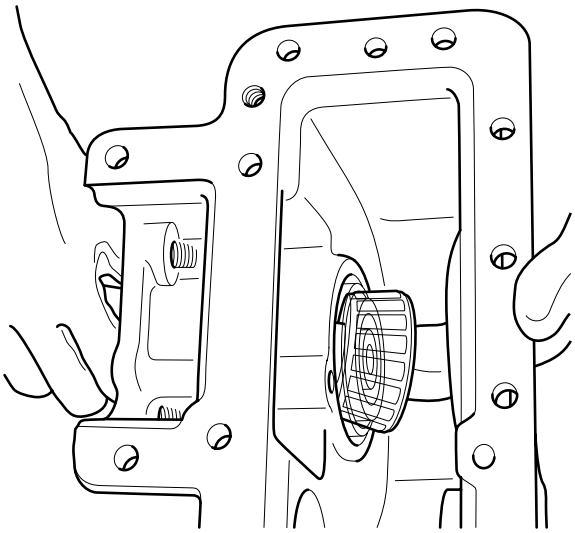
5. Fit the prop shaft and the second inner bearing into the PTO housing.



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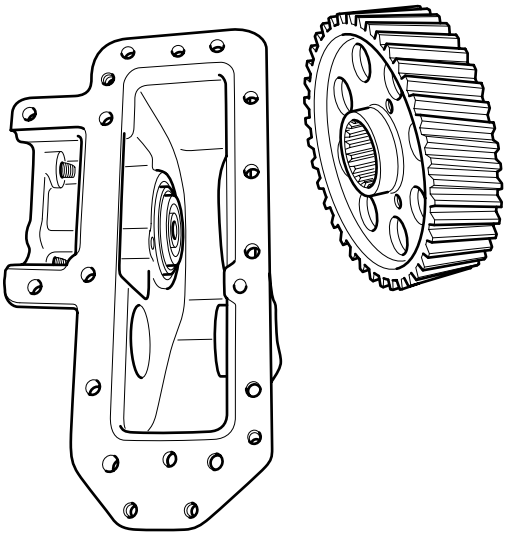
6. Use a plastic or copper mallet to install the drive sprocket in the PTO housing.



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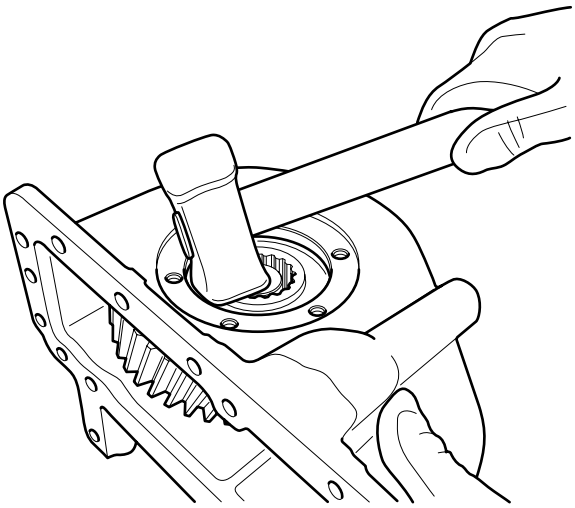

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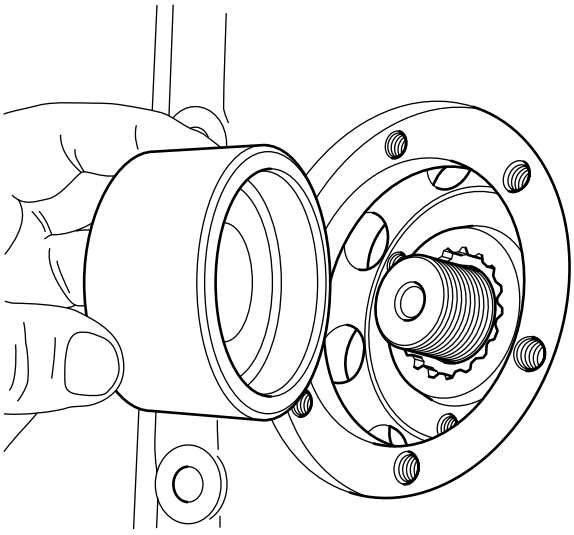
7. Place a driving tool underneath the drive sprocket.



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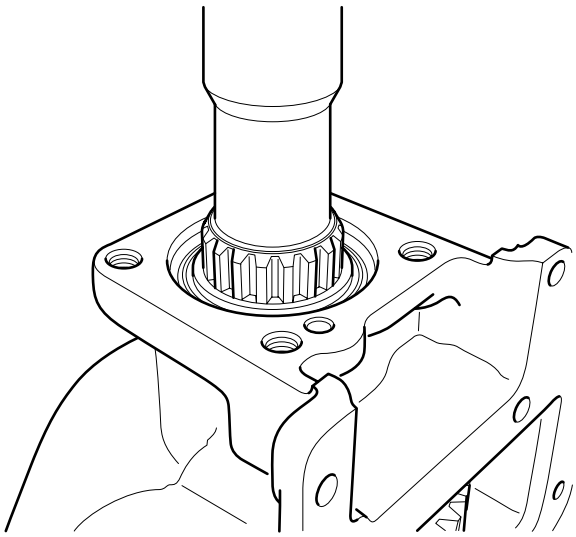
8. Now press the prop shaft into the second inner bearing and drive sprocket, which are already in the PTO housing.



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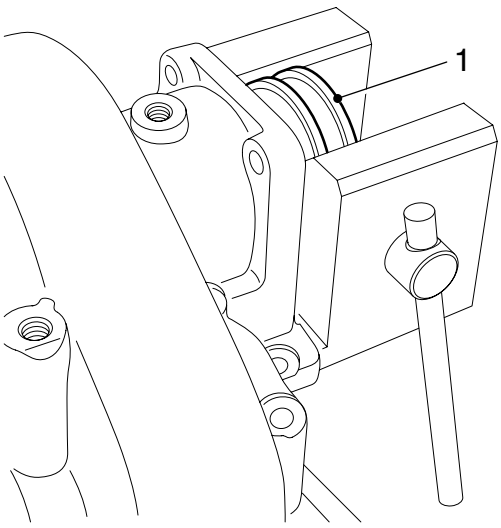
9. Place the mounting ring onto the prop shaft and clamp it firmly into a vice. Now place the PTO housing with prop shaft onto the mounting ring.
10. Apply Loctite to the prop shaft lock nut and tighten it to the specified torque. See “Technical data”.



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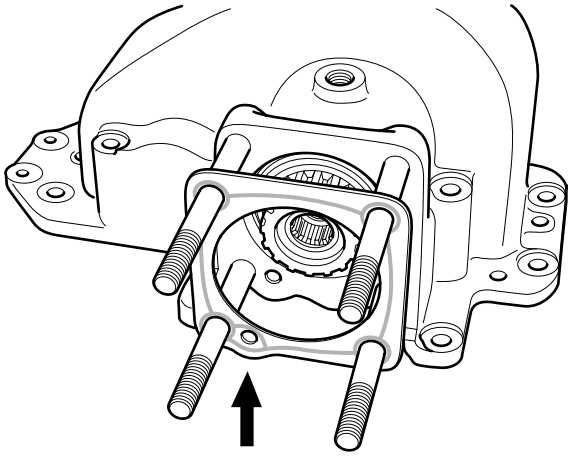
11. Fit a gasket and the cover on the PTO housing next to the lock nut and tighten the attachment bolts to the specified torque. See “Technical data”.

12. Turn the PTO housing round. If necessary, apply Loctite to the studs and tighten them to the specified torque. See “Technical data”.

13. Fit the gasket and the drive housing. Make sure that the oil channel in the gasket is exactly opposite the lubricating hole in the PTO housing.



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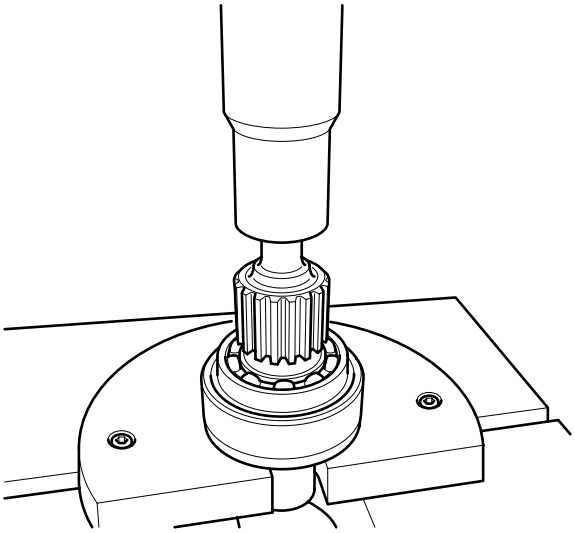
14. If necessary, fit the bearing onto the short drive shaft. Now place the circlip in the bearing.



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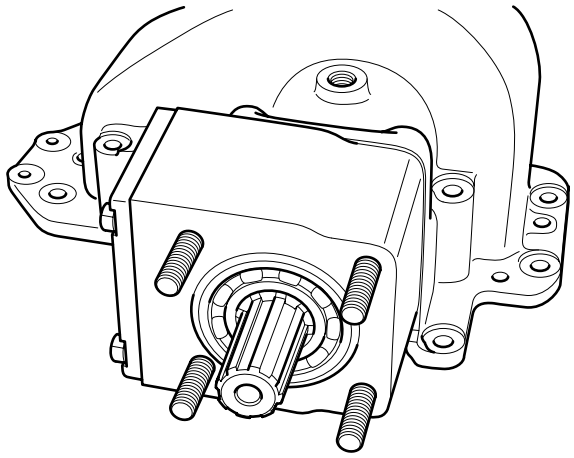
15. Fit the short drive shaft in the drive housing so that the circlip abuts the drive housing.



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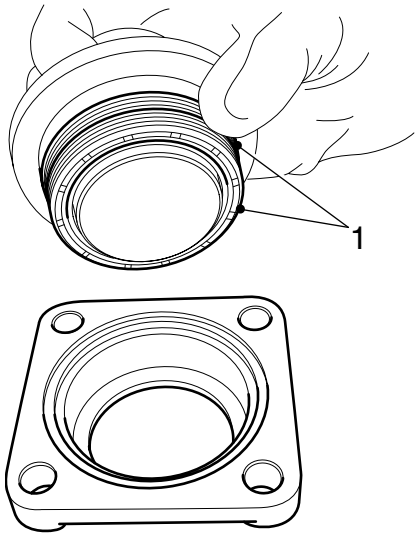
16. If necessary, fit the shaft seals (1) in the cover.
17. If necessary, fit the cover with the gasket and oil seal and tighten the attachment nuts to the specified torque. See “Technical data”.



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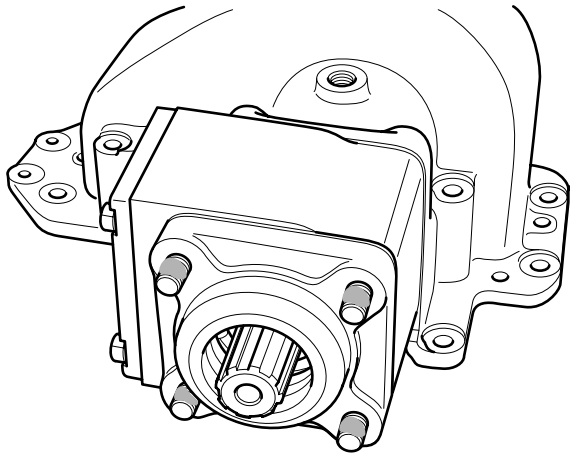
18. Apply sealant to the studs and tighten the attachment nuts to the specified torque. See “Technical data”.
19. If necessary, fit the drive flange.
20. If necessary, fit the sealing ring and O-ring and tighten the attachment bolt to the specified torque. See “Technical data”.



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5.3 VERSIONS WITH AND WITHOUT DRIVE FLANGE AND SHIFT CONTROL

Version without prop shaft flange and shift control

1. Note:
   Fit a gasket between the drive housing and PTO housing. Remember the oil channel in the gasket.
2. Fit a gasket and cover on the front of the drive housing and tighten the attachment bolts to the specified torque. See “Technical data”.
3. Fit a guide block, gasket and cover to the side of the drive housing. Tighten the attachment bolts to the specified torque. See “Technical data”.

Version with prop shaft flange and shift control

1. **Note:**
   Fit the gasket and drive housing over the studs against the PTO housing.
2. Fit a needle bearing into the prop shaft.
3. Fit the short drive shaft and bearing against the drive housing.
4. Fit the cover with gasket and oil seal against the drive housing and tighten the attachment nuts to the specified torque. See “Technical data”.
5. Fit the drive flange with locking plate and O-ring and tighten the attachment bolt to the specified torque. See “Technical data”.
6. At the rear of the selector housing, fit a sealing cap. Fit the selector housing with gasket against the drive housing and tighten the attachment bolts to the specified torque. See “Technical data”.

7. Fit the selector shaft together with the shifting fork and pressure spring into the selector housing.
8. Fit the piston with O-ring into the cylinder and mount the cylinder with a gasket on either side and the cover against the gearbox housing. Tighten the attachment bolts to the specified torque. See “Technical data”.
9. If necessary, fit a push/pull switch to the side.
10. Check the PTO control.

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CONTENTS

		Page	Date
1.	**GENERAL**	1-1	200337
1.1	System description	1-2	200337
2.	**DESCRIPTION OF COMPONENTS**	2-1	200337
2.1	Gearbox modulator	2-1	200337
2.2	Operating unit	2-4	200337
2.3	Transmission brake	2-4	200337
3.	**INSPECTION AND ADJUSTMENT**	3-1	200337
3.1	Inspection and adjustment, gearbox oil level	3-1	200337
3.2	Inspection and adjustment, gearbox output shaft bearing axial play	3-2	200337
4.	**REMOVAL AND INSTALLATION**	4-1	200337
4.1	Removal and installation, gearbox assembly with or without integrated retarder	4-1	200337
4.2	Removal and installation, gearbox modulator	4-4	200337
4.3	Removal and installation, operating unit	4-9	200337
4.4	Removal and installation, drive flange	4-13	200337
4.5	Removal and installation, output shaft oil seal	4-14	200337
4.6	Removal and installation, gearbox front cover oil seal	4-15	200337
5.	**DRAINING AND FILLING**	5-1	200337
5.1	Draining and filling, gearbox	5-1	200337

14

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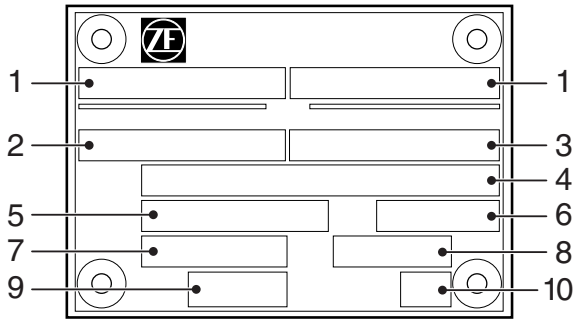
1. GENERAL

Gearbox type
Each gearbox has a type-plate attached to it, indicating the type of gearbox. This data is also stated on the identity card of the relevant vehicle.

ZF gearbox type-plate
1. Type of gearbox
2. ZF serial number
3. Parts list (ZF)
4. Specification number
5. Pulse generator ratio
6. Gearbox ratio
7. Engine speed using PTO
8. PTO speed
9. Gearbox oil capacity
10. Oil specification



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1.1 SYSTEM DESCRIPTION

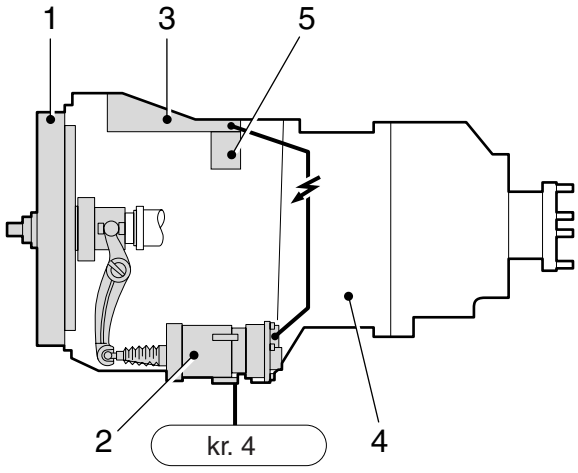
The AS Tronic gearbox (4) is a fully automatic gearbox based on a conventional mechanical gearbox combined with an electropneumatic shift and clutch control system.

The gearbox modulator (3) consists of the electronic unit, sensors, a pressure limiting valve (5) and the pneumatic shift control.

As the clutch is operated automatically, there is no need for a clutch pedal.

Clutching and declutching are effected by means of an automatic single-plate dry clutch (1), the clutch unit (2) and the modulator (3).

An operating unit enables the driver to drive the vehicle in both the semi-automatic and the fully automatic gearbox position.
The operating unit facilitates driving in the semi-automatic gearbox mode, thanks to the clear gear-change pattern on the gear lever.
In the fully automatic position, clutch and shift control takes place by the electronic shift control in the gearbox modulator.



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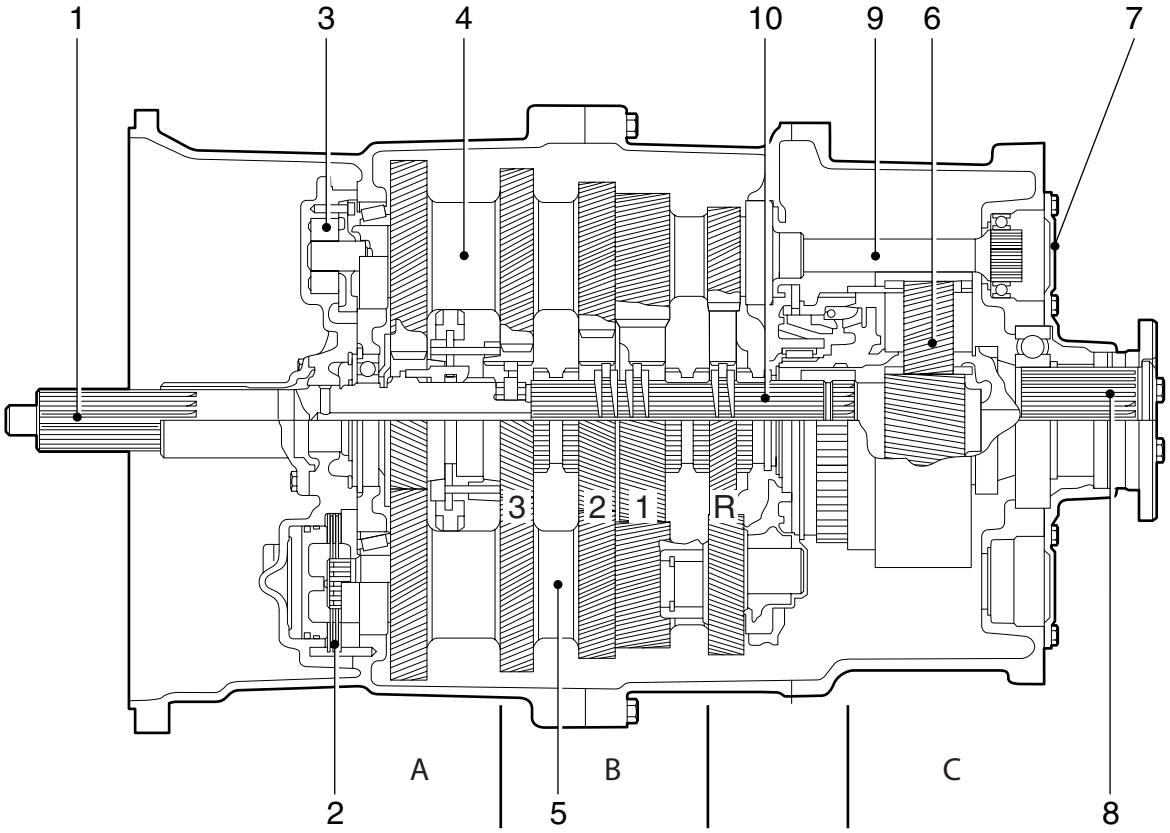


A. Integrated front-mounted range box or splitter range (two gears)
B. Main box with three or four forward gears and one reverse gear
C. Rear-mounted range box or range group (two gears)

1. Input shaft
2. Transmission brake
3. Lubricating oil pump
4. Auxiliary shaft
5. Auxiliary shaft
6. Planetary gear wheel set for rear-mounted range box
7. PTO connection point
8. Output shaft
9. PTO prop shaft
10. Main box

Two auxiliary shafts provide a favourable distribution of the input engine torque and reduce the mechanical load on the gear wheels and bearings. This construction leads to a compact, low-weight gearbox.

14

Type designation of AS Tronic gearbox
Example of type designation **12 AS 2330 TO**

12	=	12 gears
AS	=	automatic gear change
2330	=	maximum input engine torque
2331	=	version with intarder
T	=	used on trucks
O	=	Overdrive version (D = Direct drive)

A. Integrated front-mounted range box
This is a front-mounted range box accommodated in the front gearbox housing. Using an additional set of gears, the auxiliary shafts of the main box can be driven by two different ratios. In this way, each gear in the main box can be engaged in a low or high ratio or split into two. The number of gears in the main box is thereby doubled. The front-mounted range box has been synchronised so as to restrict the number of times the transmission brake is activated.

B. Main box
The main box consists of three or four forward gears and one reverse gear. The main box has not been synchronised; synchronisation is effected by means of the transmission brake and UPEC. The splitter and rear-mounted range boxes are synchronised.

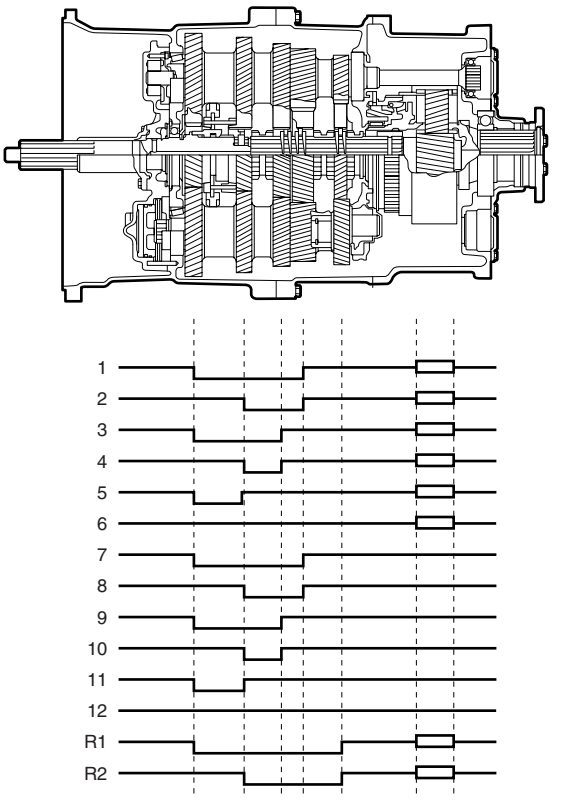
C. Planetary rear-mounted range box
This is a gearbox mounted against the rear of the main box, consisting of a planetary gear wheel set.

Using this set of gears, all gears of the main box can be used once with the rear-mounted range box in a low ratio and once with the rear-mounted range box in a 1:1 ratio.
The number of gears in the main box is thereby doubled.

In popular terms, the number of gears in the main box is “stacked”. This is why the term “stacking box” or range box was created.

The diagrams show the power distribution across the individual gear pairs for each gear.

AS Tronic 12 gears
By means of the splitter range, the three gears in the main box are multiplied by two, while using the rear-mounted range box multiplies this figure by two again. This results in 2x3x2 = 12 forward gears.



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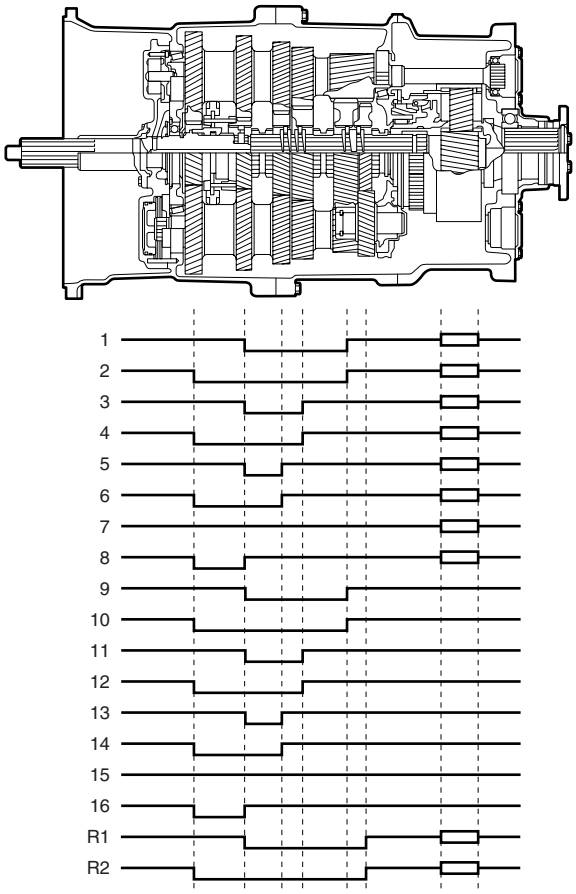
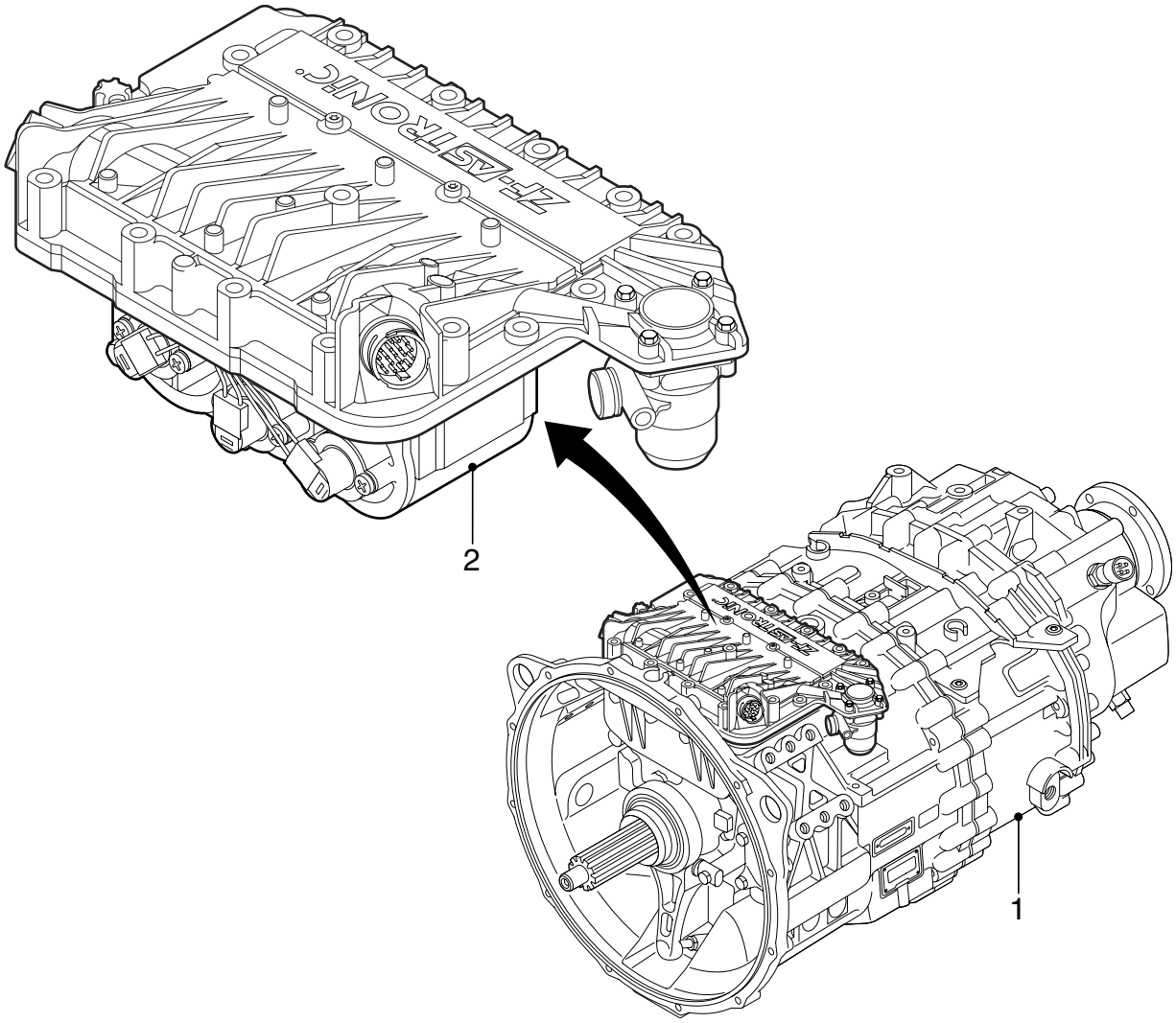
AS Tronic 16 gears
By means of the splitter range, the four gears in the main box are multiplied by two, while using the rear-mounted range box multiplies this figure by two again. This results in 2x4x2 = 16 forward gears.



2. DESCRIPTION OF COMPONENTS

2.1 GEARBOX MODULATOR

The gearbox modulator (2) is integrated in the gearbox housing (1) (to save space) and has all mechanical, electrical and pneumatic connections that are necessary for correct shifting of the gearbox.



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The gearbox modulator is to ensure that the gearbox shifts fast and correctly, depending on the current driving conditions.
All functions that are necessary for selection and checking of the correct gear are controlled inside the gearbox modulator.

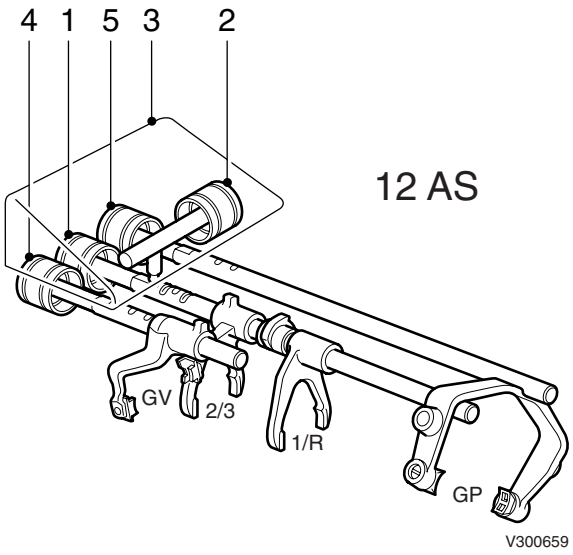
The gearbox modulator contains the following components:
- The control unit (ECU)
- Pneumatic solenoid valves and engaging cylinders
- Travel sensors to determine the current position of all engaging cylinders
- Sensors for checking the gearbox and modulator temperatures, rpm of input shaft and pressure sensor for the air supply to the pneumatic system

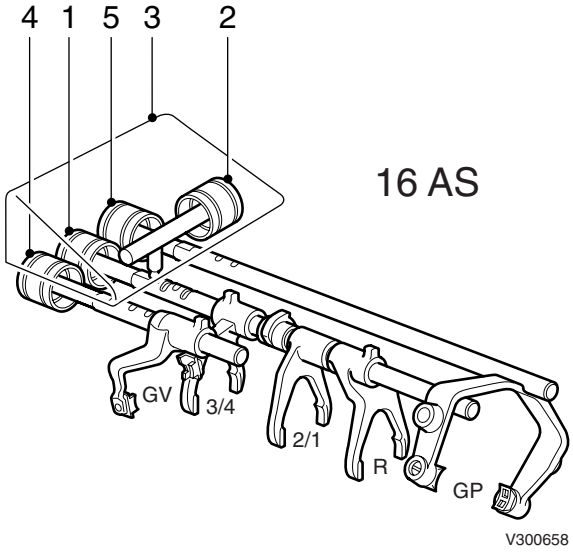
The integrated gearbox electronics are situated in the upper modulator cover. The electronics serve to actuate and control the entire automated gear selector system (gearbox, clutch, PTO), depending on the driving conditions (correct gear, fully automatic mode, operating condition of the vehicle).

Electropneumatic actuation of the gearbox control is effected by 10 individual pneumatic solenoid valves.
One solenoid valve functions as the main cut-off valve for the air supply. A combination of 8 solenoid valves ensures that the engaging cylinders (1, 2, 4 and 5) are actuated. One solenoid valve actuates the transmission brake via an air duct in the gearbox housing.

Engaging cylinder 1 engages the main box and the selector cylinder (2) ensures that the right gate is selected for the main box.
The splitter range (GV) is operated by engaging cylinder 4. The rear-mounted range box (GP) is operated by engaging cylinder 5.

The figures alongside show the situations with a 12AS or 16AS gearbox.

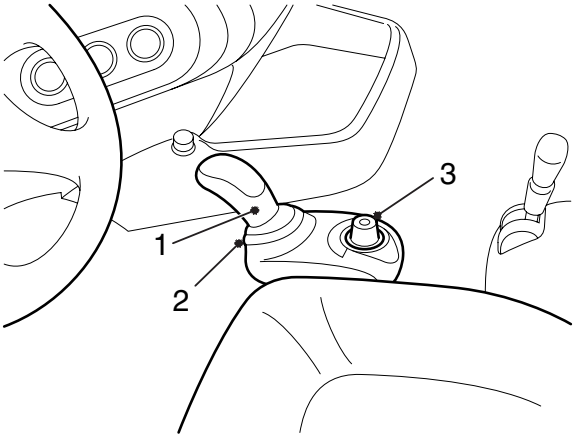




2.2 OPERATING UNIT

The operating unit (2) is not mechanically connected to the gearbox. Operation is effected via the selector switch (3) and the gear lever (1).

The operating unit contains various position sensors that register the position of the gear lever.
In this way the information relating to the correct gear is transmitted to the gearbox modulator via the internal electronics of the operating unit and the cab wiring.



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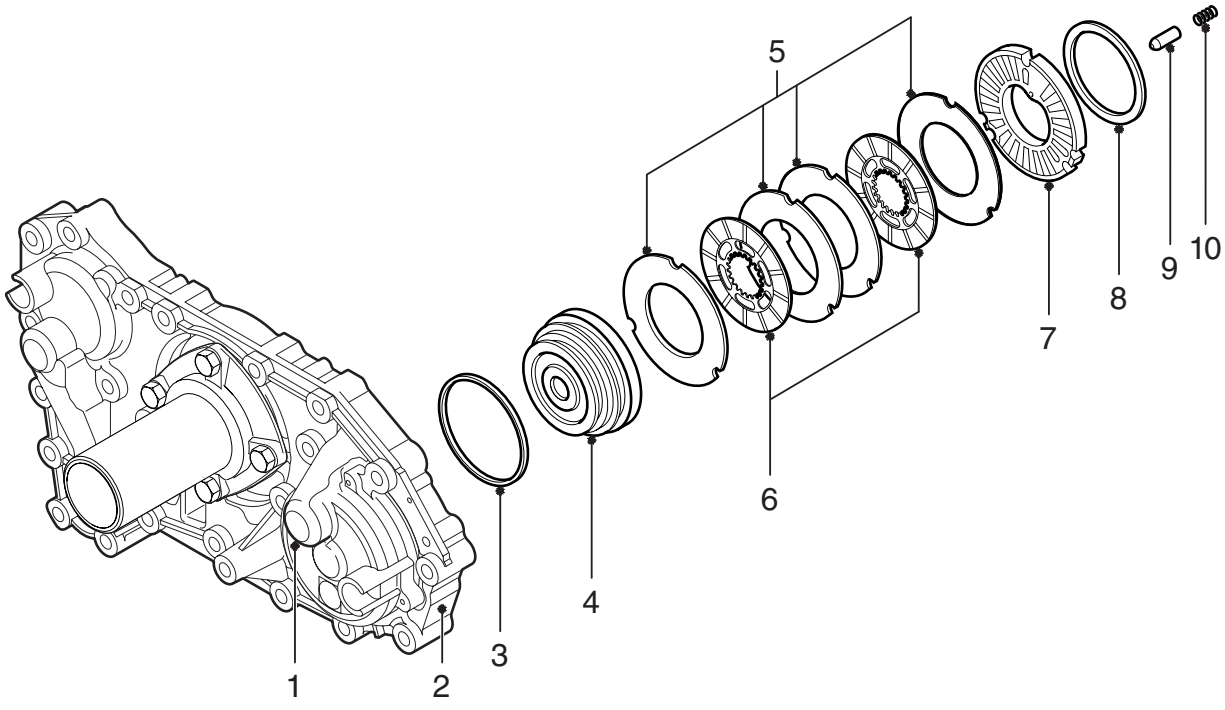
2.3 TRANSMISSION BRAKE



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The transmission brake is located in the front gearbox cover (2), which is situated in the clutch housing. The transmission brake consists of a piston (4), multiple lamella clutch (5, 6) and the clutch cover (7).

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The transmission brake is operated pneumatically by the piston (4). During changing up the speeds of the secondary shafts, and therefore the speeds of the main-box gear wheels too, must be braked in respect of the main shaft.
This is necessary so as to engage a subsequent gear and because the main box has not been synchronised.

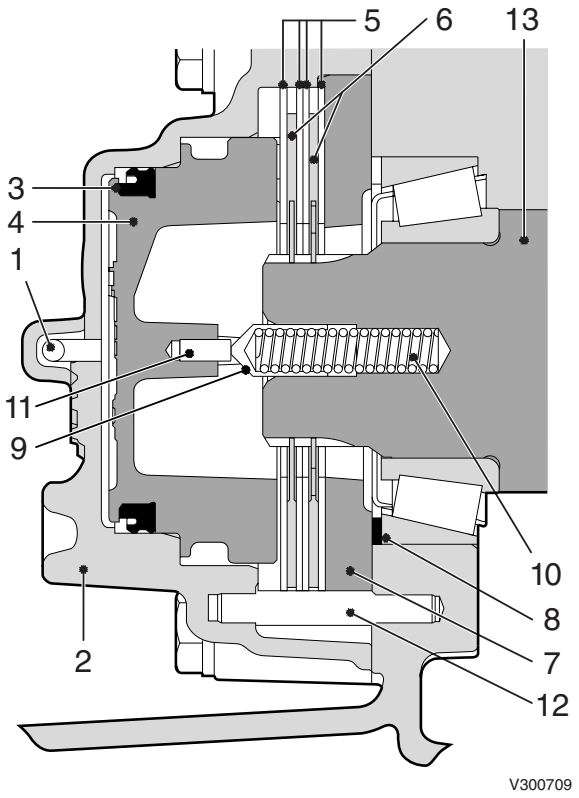
The transmission brake is actuated by a solenoid valve in the gearbox modulator. This valve actuates the piston (4) pneumatically via an air duct in the gearbox housing and the air duct (1) in the cover.

The adjustable air pressure will cause the piston (4) to move the lamellae (5, 6) against the clutch cover (7). The clutch cover (7) and the pressure plates (5) are locked in position relative to the gearbox housing by means of recesses and pins (12).

In this way the auxiliary shaft (13) can be braked, so that gears can be shifted.

After a change of gear, the clutch of the transmission brake is no longer operated. The spring (10) and hollow pin (9) in the auxiliary shaft (13) force the piston back, so that the clutch is released.

A metal hit pin (11) serves to reduce wear of the lightweight-metal piston (4).



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3. INSPECTION AND ADJUSTMENT

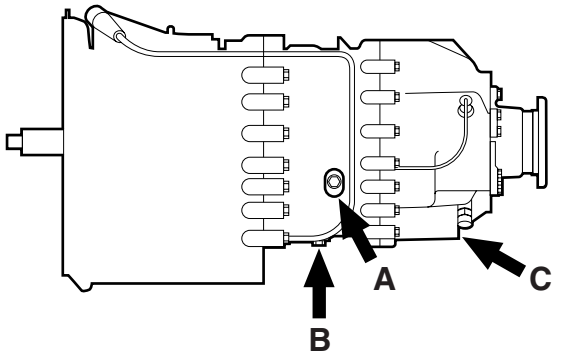
3.1 INSPECTION AND ADJUSTMENT, GEARBOX OIL LEVEL

To prevent skin injury, avoid unnecessary contact with the drained oil.

AS Tronic gearbox

1. Position the vehicle on a level surface.
2. Wait for some minutes to allow the oil to flow back.

   Note:
   The oil level must reach the rim of the level check/filler opening (A).
3. Remove the level check plug (A) and check the oil level.
4. After checking the oil level, tighten the level check plug (A) to the specified torque. See “Technical data”.



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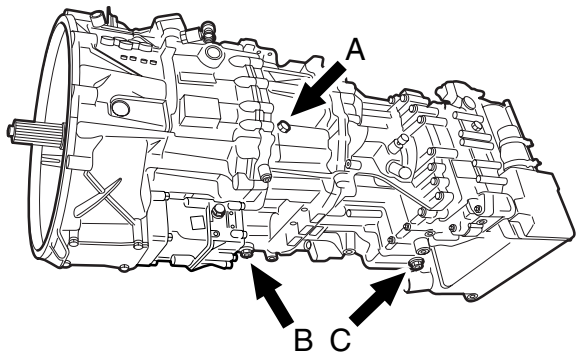
AS Tronic gearbox with integrated retarder

1. Place the vehicle on a level surface. Apply the brakes without activating the retarder.
2. Wait for some minutes to allow the oil to flow back.

   Note:
   The oil level must reach the rim of the level check/filler opening (A).
3. Remove the level check plug (A) and check the oil level.
4. After checking the oil level, tighten the level check plug (A) to the specified torque. See “Technical data”.



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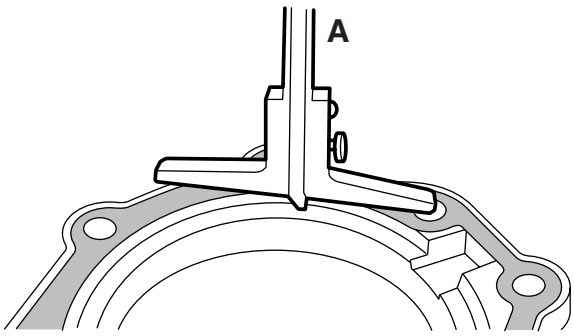
3.2 INSPECTION AND ADJUSTMENT, GEARBOX OUTPUT SHAFT BEARING AXIAL PLAY

1. Remove the drive flange.
2. Remove the rear gearbox bearing cover.
3. Clean the sealing surfaces of the bearing cover and the gearbox.
4. Use a depth gauge to determine the depth of the bearing cover recess, distance A.



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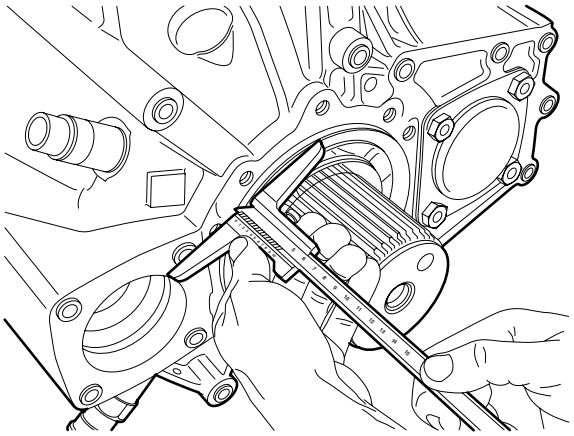
5. Use a depth gauge to determine the height the ball bearing protrudes above the gearbox housing, distance B.
6. Calculate the axial play. The axial play equals distance A - distance B.
7. Compare the calculated value with the maximum allowable axial play. See “Technical data”.
8. If necessary, adjust the axial play by means of another adjusting ring.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4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION, GEARBOX ASSEMBLY WITH OR WITHOUT INTEGRATED RETARDER

Removing the gearbox assembly

1. Disconnect the earth lead from the battery terminal.
2. Disconnect the prop shaft from the gearbox flange and hang it on the chassis.
3. Bleed the air reservoir for the AS Tronic (circuit 4) and remove the air reservoir.
4. Remove the clutch unit.
5. Remove the gearbox modulator connector at the right-hand side.
6. Remove the complete wiring harness conduit on the right-hand side of the gearbox and hang it on the chassis.
7. Remove the air pipe from the pressure regulator on the side of the gearbox.
8. If necessary, remove the section of the exhaust pipe underneath the gearbox.
9. Place a jack underneath the gearbox and remove the gearbox attachment bolts around the clutch housing.

   Note:
   When the gearbox is removed from the engine, the thrust bearing remains in the clutch release assembly.
10. Use the jack to pull the gearbox away from the engine and remove it.

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Installing the gearbox

1. Install the thrust bearing over the gearbox front cover and check whether the retainer clip in the clutch release assembly is closed.

   Note:
   Carefully rotate the input shaft using extended pliers while fitting the gearbox, so that the input shaft can slide into the clutch plate upon assembly.

2. Use the jack to move the gearbox towards the engine and install the attachment bolts around the gearbox.

3. Using the clutch lever, press the thrust bearing into the clutch release assembly. The clutch lever can no longer be moved by hand when the thrust bearing is fitted correctly in the clutch release assembly.

4. Fit the clutch unit.

5. If the exhaust pipe was removed, reinstall it.

6. Fit the cable conduit on the right-hand side of the gearbox.

7. Connect the connector of the gearbox wiring harness on the vehicle side.

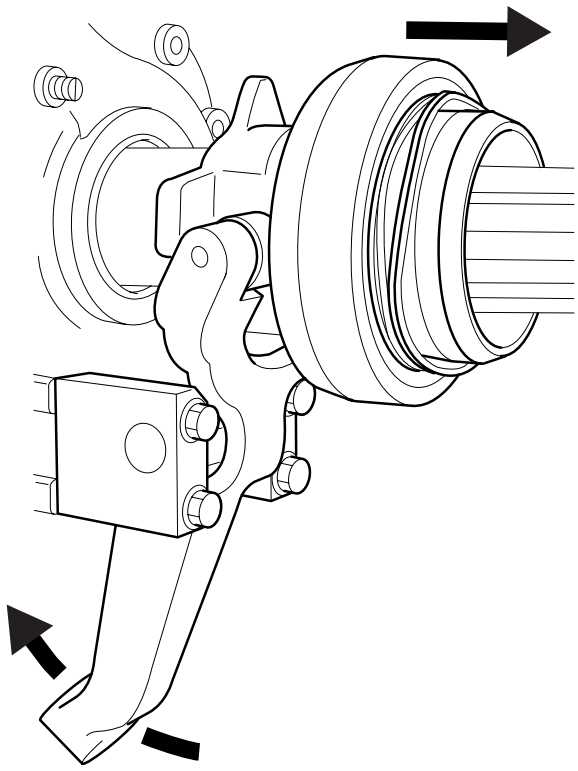
8. Install the air reservoir for AS Tronic.

9. Connect the air pipes of the pressure regulator on the side of the gearbox.

10. Attach the prop shaft.

11. Reconnect the earth lead to the battery terminal.

12. If a gearbox of a different type or with a different reduction is mounted, this should be reported.



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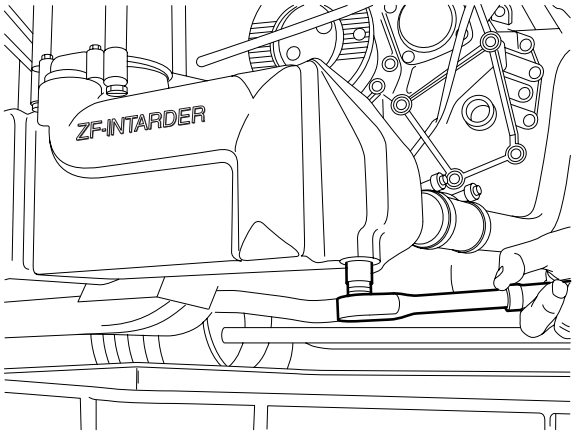
Removing the gearbox with integrated retarder

1. Disconnect the earth lead from the battery terminal.
2. Drain the engine coolant.
3. Remove the drain plug of the intarder heat exchanger and drain the coolant.
4. Remove the coolant pipes from the retarder.
5. Remove the coolant pipes between the retarder and the engine.
6. Disconnect the electrical connectors and remove the air pipes from the retarder.
7. Remove the gearbox including the retarder.



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Installing the gearbox with integrated retarder

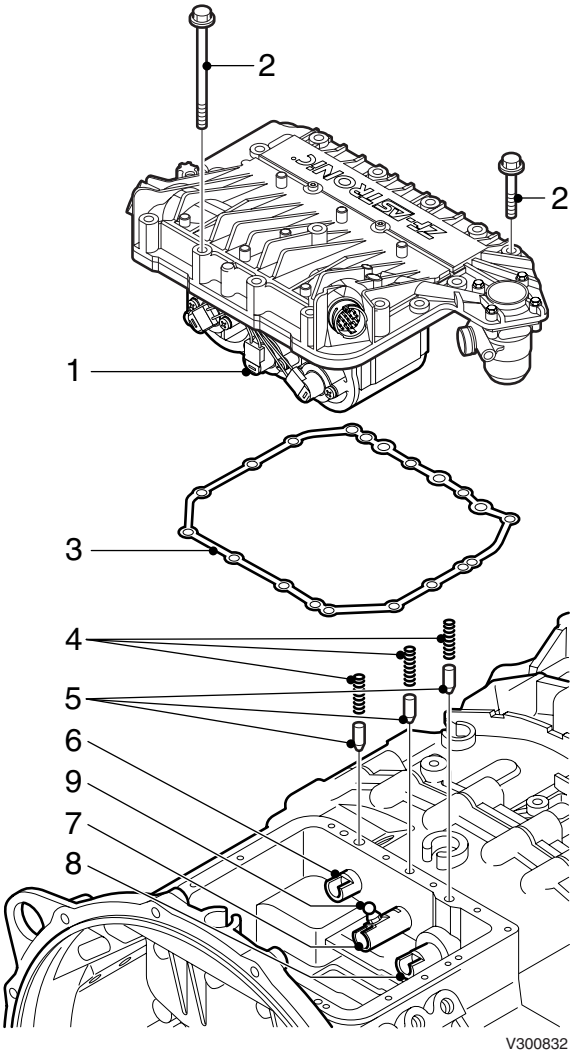
1. Fit the gearbox.
2. Install the coolant pipes between the retarder and the engine.
3. Fit the drain plug of the intarder heat exchanger.
4. Connect the coolant pipes to the retarder.
5. Connect the electrical connectors and fit the air pipes of the retarder.
6. Fill the cooling system.
7. Check/fill the gearbox and integrated retarder with oil.

4.2 REMOVAL AND INSTALLATION, GEARBOX MODULATOR

Removing the gearbox modulator

1. Disconnect the earth lead from the battery terminal.
2. Remove the pressure regulator air pipe from the gearbox modulator.
3. Remove the gearbox.
4. Remove the attachment bolts (2) and the gearbox modulator (1).

   Note:
   When removing the gearbox modulator, take care that the seal or parts of it does not fall into the gearbox.
5. Remove the seal (3) and clean the sealing surfaces.



Installing the gearbox modulator

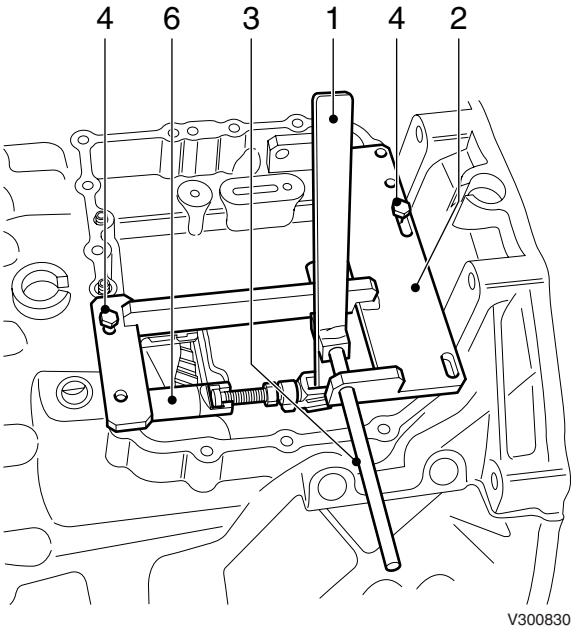
Seal the freed opening of the gearbox with a clean cloth, so that no objects can fall into the gearbox while the selector shafts are being adjusted.

1. Fit the special tool (2) (DAF No. 1453138) and secure it using the bolts (4).

CAUTION!
Always put the central selector shaft (7) at a slant before moving it. This means that the round bolt (9) points either to the left or to the right.

2. Put the central selector shaft (7) in the neutral position using the special tool. Align the outer two selector shafts (6 and 8) with the central selector shaft (7) using the special tool.

Note:
The lever (1) must be moved twice before the selector shafts are adjusted. To do so, remove the pin (3) so that the lever can be fitted in the new position.



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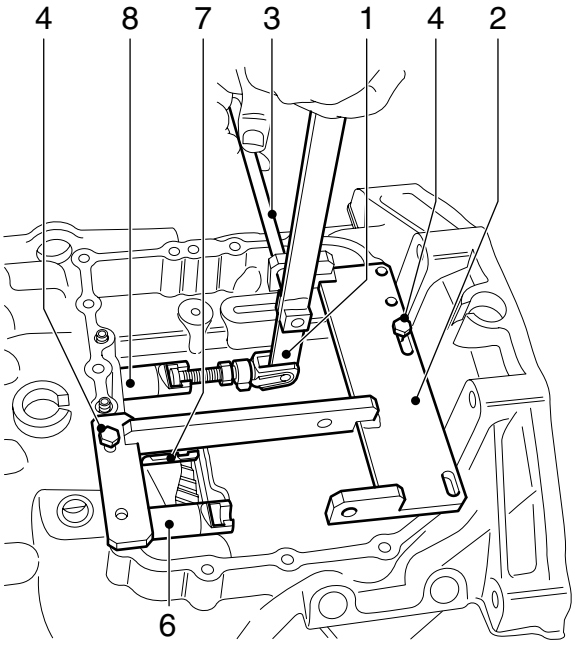

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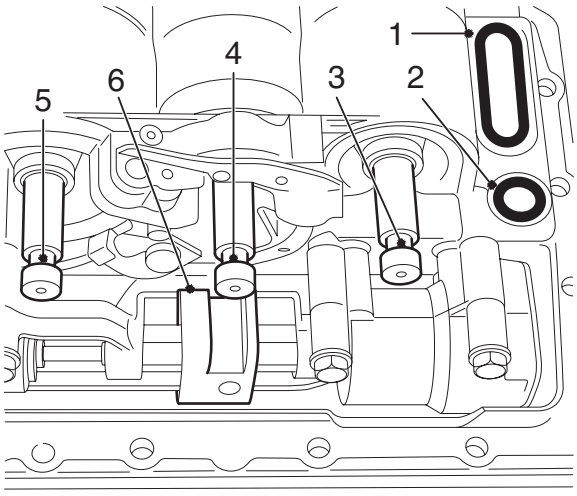
3. Put the central modulator control rod (4) in neutral position; this is reached when a slightly higher resistance is met when the control rod is drawn out.
4. Align the two outer control rods (3 and 5) and the central rod.



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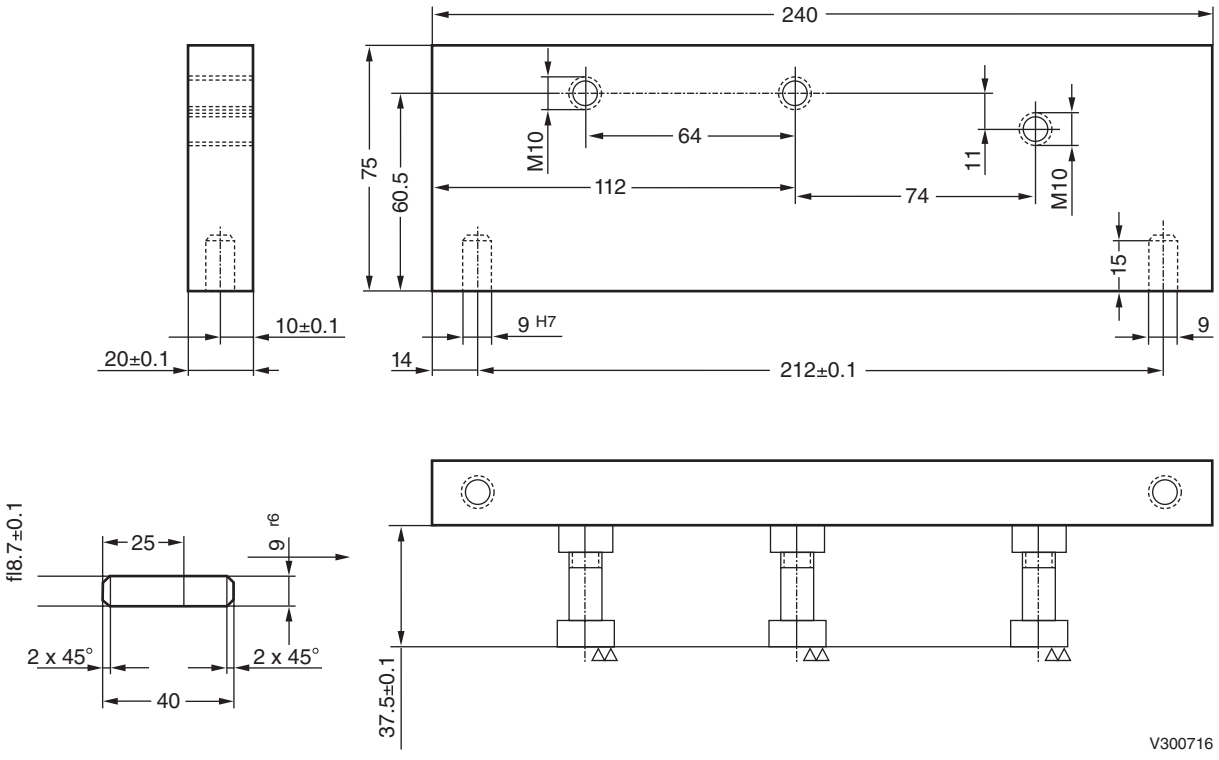
Note:
The alignment of the control rods can be checked with the aid of a simple tool. This tool can be made in your own workshop. It cannot be ordered from DAF.



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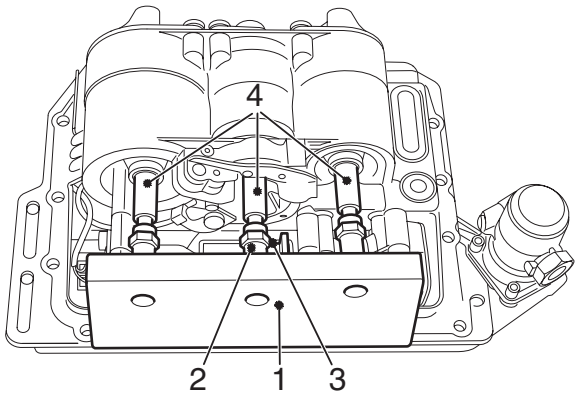
5. Check that the control rods (4) are properly adjusted, using the tool (1) if necessary.



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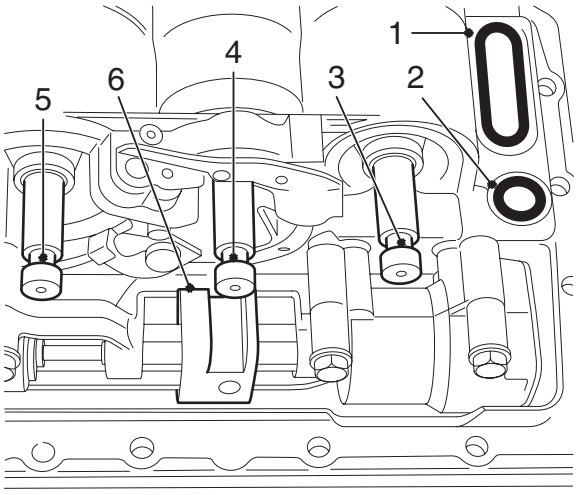
6. Put the recess of the pad (6) on the selection cylinder exactly in the centre of the control rod (4).

   Note:
   Ensure that the rubber seals (1 and 2) are fitted on the modulator and are not damaged.



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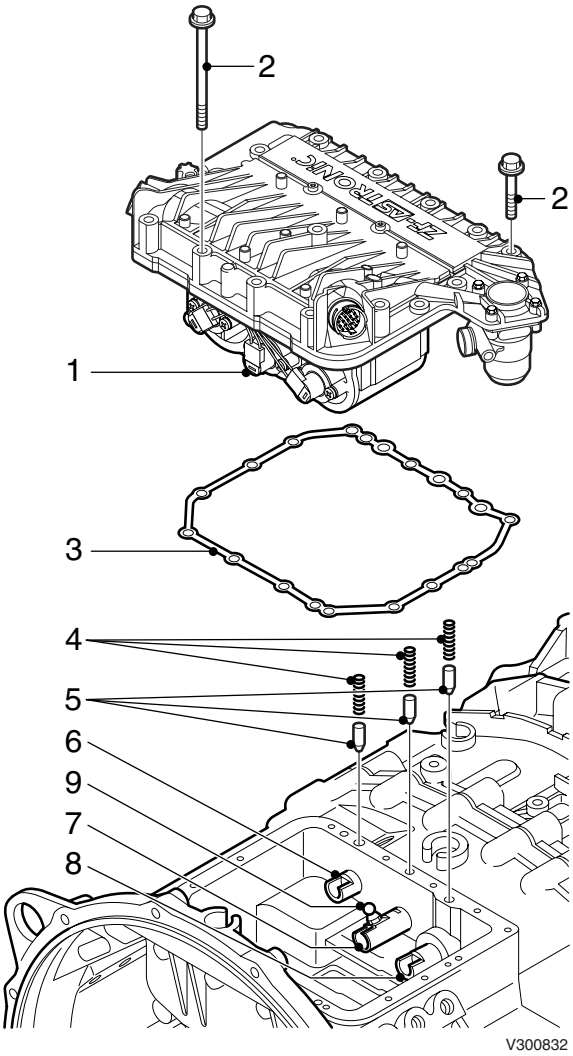
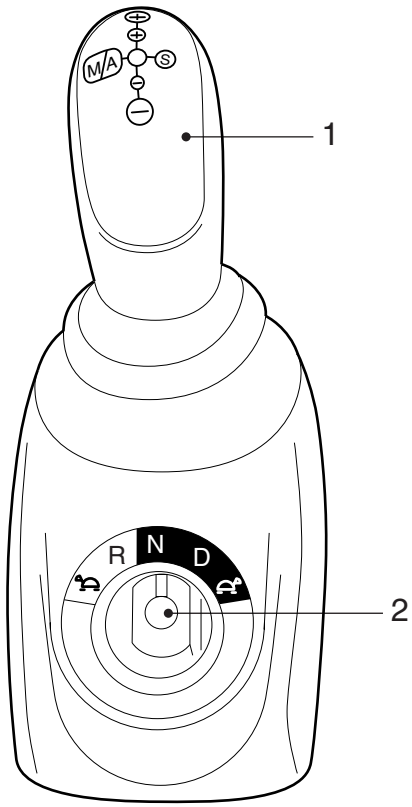
7. Put the round bolt (9) in upright position; it has to fall into the recess of the pad on the selection cylinder.
8. Install the gearbox modulator (1) with a new seal (3); see that the control rods fall into the recesses in the selector shafts (7, 8 and 9). Tighten the bolts (2) to the specified torque. See “Technical data”.
9. Fit the gearbox.
10. Connect the battery terminal.
11. The new gearbox modulator must **always** be reprogrammed using DAVIE XD and the correct vehicle data.



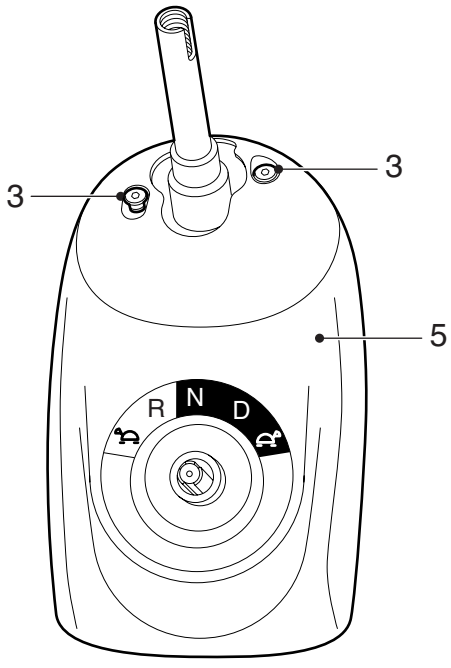
4.3 REMOVAL AND INSTALLATION, OPERATING UNIT

Removing the operating unit

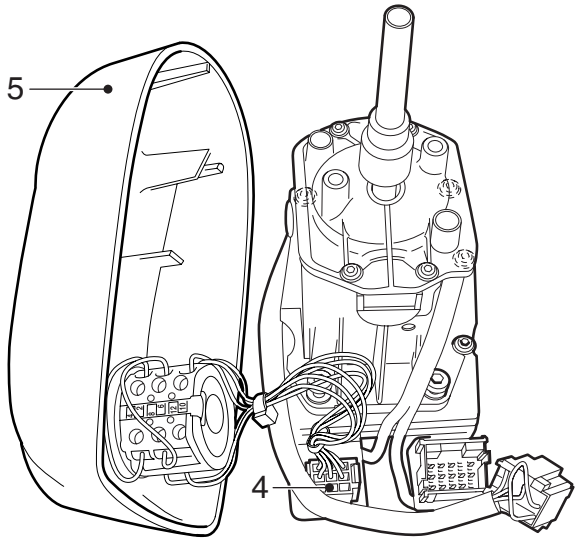
1. Remove the gear lever cover (1) and the cap (2) from the selector switch button.
2. Remove the attachment bolt from the gear lever knob and the knob from the selector switch. Remove the gear lever knob and bottom plate and the knob from the selector switch.



3. Remove the bolts (3) from the cover (5) and lift the cover (5).



4. Disconnect connector 4 from the selector switch. Remove the cover (5) with the selector switch.



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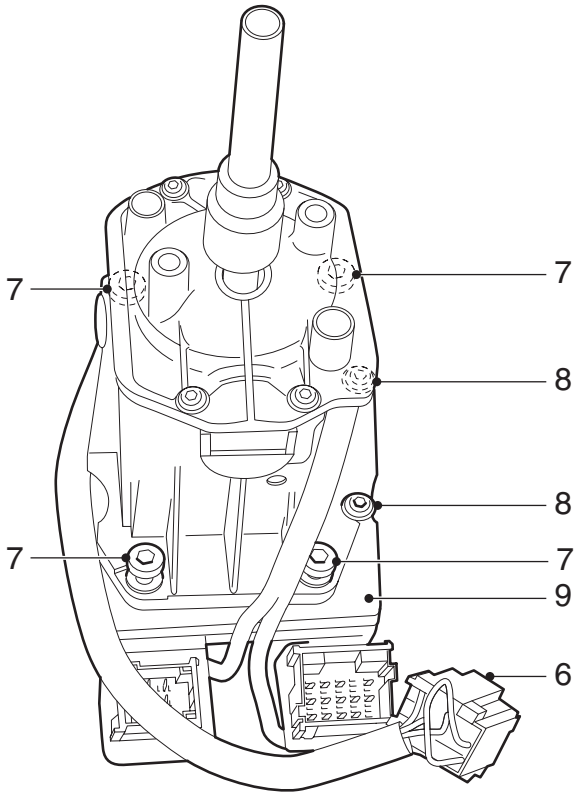
5. Disconnect connector 6 and remove the attachment bolts (7) from the gear lever unit; lift the gear lever unit and remove the bolts (8) from the bottom plate (9). Remove the gear lever unit with the bottom plate (9).



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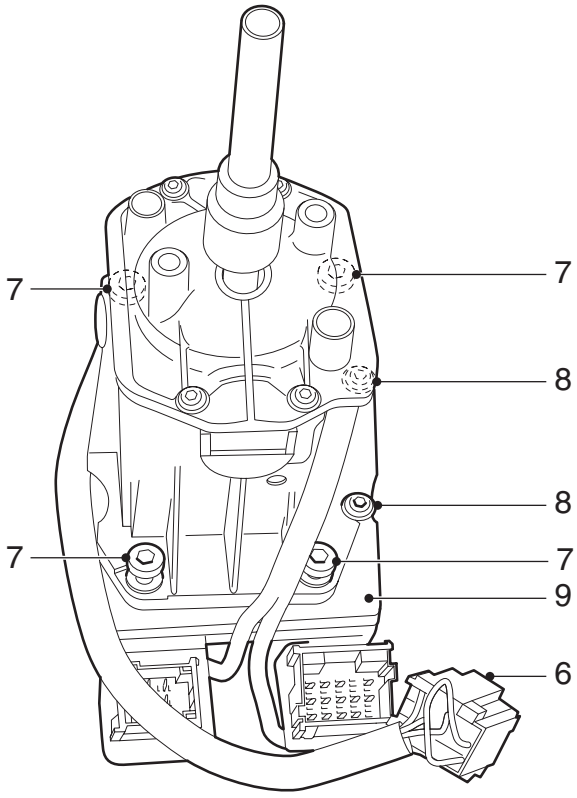
Fitting operating unit assembly

1. Install the bottom plate (9) with the gear lever unit and fit connector 6.



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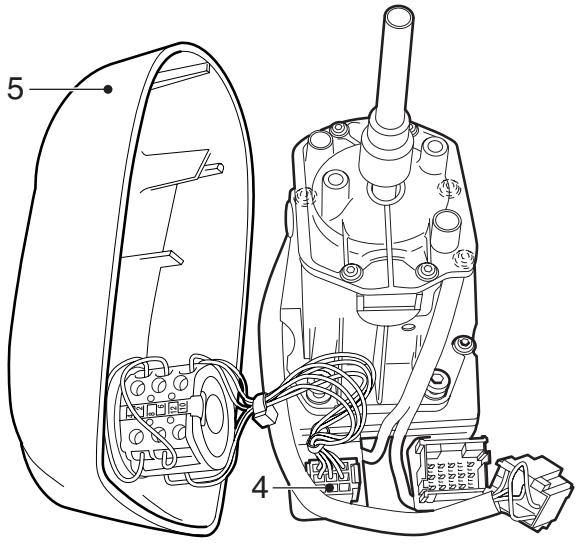
2. Connect connector 4 and fit the cover (5) with the selector switch.

   Note:
   Take care that the locking mechanism that is fitted to prevent the bottom plate from rotating relative to the gear lever does not break during installation.



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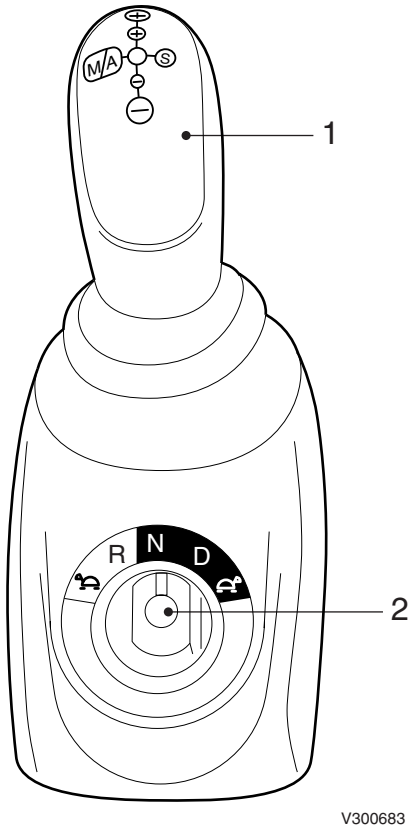
3. Install the gear lever knob and the bottom plate. Fit the attachment bolt and position the cover (1).
4. Fit the selector switch knob. Fit the attachment bolt and the cap (2).



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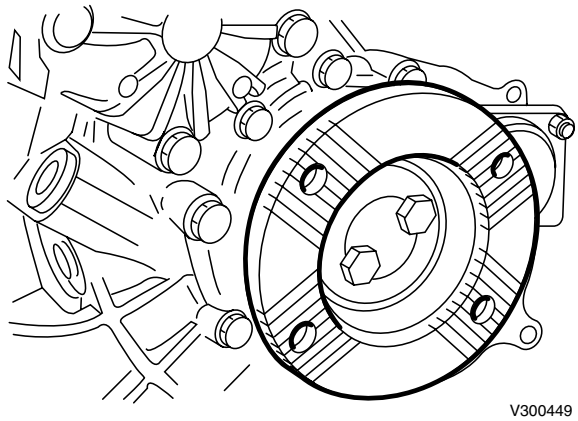
4.4 REMOVAL AND INSTALLATION, DRIVE FLANGE

Removing drive flange

1. Remove the prop shaft from the gearbox flange and hang it on the chassis.
2. Hold the drive flange in place with the special tool (DAF No. 0484977).
3. Remove the attachment bolts from the drive flange.
4. Remove the bolts and locking plate with seal from the drive flange.
5. **Note:**
   Measure and make a note of the distance from the drive flange to the shaft. The same distance must be observed when the drive flange is reinstalled.

   Remove the drive flange and O-ring using a commercially available puller.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Installing drive flange

1. Lightly oil the sealing ring in the bearing cover.
2. Heat the drive flange to 70°C. Slide it as far as possible onto the output shaft. Use the locking plate and two standard bolts (M12x75) to pull the drive flange further onto the shaft.
3. Remove the standard bolts and measure whether the drive flange has reached the correct position on the output shaft.
4. Fit a new O-ring into the recess between the output shaft and the drive flange.
5. Hold the drive flange in place with the special tool (DAF No. 0484977).
6. **Note:**
   Bolts that will be re-used must be cleaned and lightly oiled.

   Tighten the attachment bolts to the specified torque. See “Technical data”.
7. Attach the prop shaft.

4.5 REMOVAL AND INSTALLATION, OUTPUT SHAFT OIL SEAL

Removing the output shaft oil seal

1. Remove the prop shaft from the gearbox flange and hang it on the chassis.
2. Remove the drive flange.
3. Drill two holes into the external cover of the oil seal and turn the special tool (DAF No. 0484899) into the oil seal. Then pull the oil seal out of the bearing cover using the special tool (DAF No. 0694928).

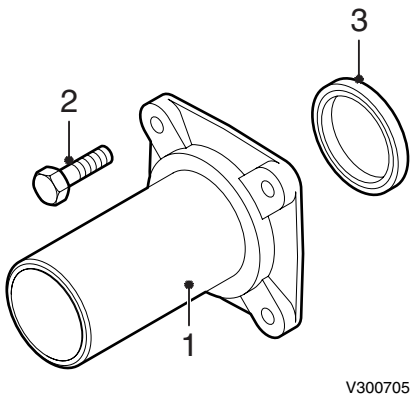
Installing the output shaft oil seal

1. Apply methylated spirit to the outer circumference of the oil seal. Apply a little grease to the sealing lip.
2. Fit the oil seal into the bearing cover using the special tool (DAF No. 1453146 in combination with 1453148).
3. Fit the drive flange.
4. Attach the prop shaft.

4.6 REMOVAL AND INSTALLATION, GEARBOX FRONT COVER OIL SEAL

Removing the gearbox front cover oil seal

1. Remove the gearbox.
2. Remove the clutch lever from the clutch housing.
3. Unscrew the attachment bolts (2) from the gearbox front cover (1) and remove it.
4. Remove the oil seal (3) from the gearbox front cover.
5. Clean the sealing surfaces of the gearbox front cover and the gearbox housing.



Installing the gearbox front cover oil seal

1. Apply methylated spirit to the outer circumference of the oil seal and install the seal in the gearbox front cover using the special tool (DAF No. 14553145).
2. Install the gearbox front cover with liquid gasket and tighten the attachment bolts to the specified torque. See “Technical data”.
3. Fit the clutch lever in the clutch housing and tighten the attachment bolt to the specified torque. See “Technical data”.
4. Fit the gearbox.

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5. DRAINING AND FILLING

5.1 DRAINING AND FILLING, GEARBOX

AS Tronic gearbox

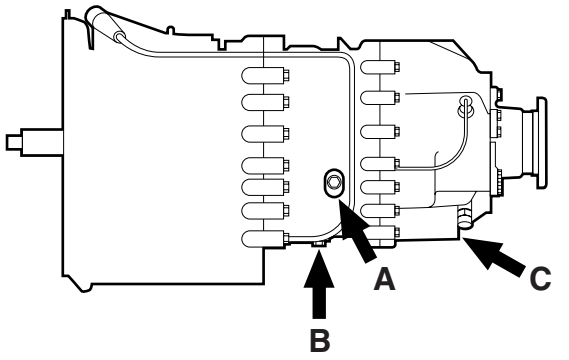
To prevent skin injury, avoid unnecessary contact with the drained oil.

Draining the gearbox

1. Position the vehicle on a level surface.
2. Drain the gearbox at operating temperature.
3. Remove drain plugs B, C and D and the level check/filler plug (A) and drain the oil.

Filling the gearbox

1. Clean drain plugs B, C and D and tighten them to the specified torque. See “Technical data”.
2. Fill the oil through the level check/filler opening (A) until the oil reaches the rim of the filling opening.
3. Fit the level check/filler plug (A), tightening it to the specified torque. See “Technical data”.



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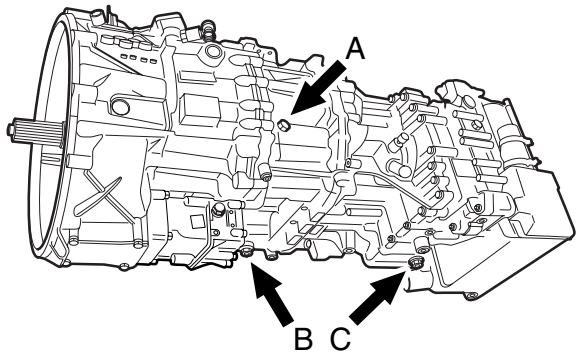
AS Tronic gearbox with integrated retarder

Draining the gearbox

1. Before draining take a short test drive. **Do not** activate the retarder during the test drive.
2. Position the vehicle on a level surface.
3. Drain the gearbox at operating temperature.
4. Remove drain plugs B and C and the level check/filler plug (A) and drain the oil.
5. Replace the filter element in the gearbox. See “Removal and installation”.



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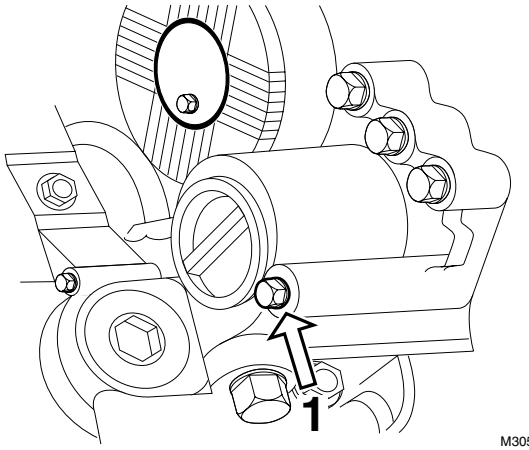
Filling the gearbox

1. Clean the drain plugs and tighten them to the specified torque. See “Technical data”.
2. Top up oil through level check/filler opening (A) until the oil reaches the rim of the filler opening (A).
3. Fit the level check/filler plug (A), tightening it to the specified torque. See “Technical data”.
4. After filling take a short test drive. **Do not** activate the retarder during the test drive.
5. Check the oil level after taking the test drive. The oil level must reach the rim of the level check/filler opening (A).
6. Fit the level check/filler plug (A), tightening it to the specified torque. See “Technical data”.



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